Creating a Teaching Landscape

A landscape master plan for Fisherville Mill

for the town of Grafton, Massachusetts

Hillary Collins, Jillian Ferguson, Jeff Frisch jr.
The Conway School
Spring 2015

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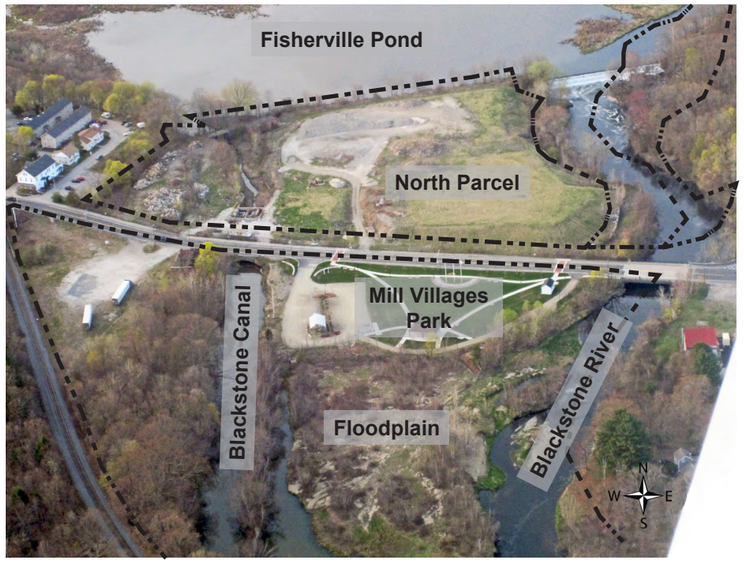
Creating a Teaching Landscape

The Fisherville Mill site is an industrial brownfield located in the southwestern corner of Grafton, Massachusetts. In the past two decades, the site has been heavily remediated and is in the process of being transformed into a community space and landscape that teaches visitors about its industrial past, the ongoing remediation and regeneration of the site, and its future possibilities.

Local Park Ranger gives a tour about the site's history.

The Living Systems Laboratory is home to a biological remediation system that uses myco-reactors and other plant species to clean water contaminants from the Blackstone Canal.

Students help prepare the myco-reactors for the Living Systems Laboratory.



The 32-acre site includes the northern parcel, where the Fisherville Mill was located. The southern parcel is made up of the Mill Villages Park and the floodplain with the Blackstone Canal and the Blackstone River on either side. The western side of the property is reserved for for future development.

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Grafton's Planning Department received a "Creating a Teaching Landscape" grant from the Blackstone River Valley National Heritage Corridor, to engage visitors of the Fisherville site who, through trails and interpretive nodes, can learn about the site's history, culture, and ecology. Components funded by the grant include:

- This landscape master plan by the **Conway School** students for the Fisherville Mill Site, the Mill Villages Park, the Living Systems Laboratory, and its historic and environmental resources. The plan proposes footpaths and boardwalks leading to areas of the site that offer interpretive and aesthetic opportunities.
- An inventory and catalogue of plant and animal species by **Clark University** students to incorporate into educational material, including physical and online formats, in order to support a walking tour by local schools, universities, and visitors to the site.
- Project oversight, general administrative support, public outreach, and technical expertise by the **Town of Grafton**.

Other key contributors include Grafton residents, the National Park Service, the Blackstone River Valley National Heritage Corridor, and property owner Gene Bernat.

The Conway School's contribution

This landscape master plan represents the first stage of a year-long process outlined by the grant. The team worked closely with the property owner and client, Gene Bernat, as they created plans that emphasize and connect the environmental, cultural, and historical elements of the site and surrounding area. This document contains historical context for the site and region, analysis of existing conditions, alternative designs, and a final design that includes design details, construction details, precedents, a grading plan, cost estimates, and a plant palette.

The goals of the master plan are to:

1. Identify unique features and destinations of interest.

2. Design trail alignments and possibilities for future connections to larger trail networks off site.

3. Explore options for locating interpretive materials and exhibits.

4. Re-site and expand the Living Systems Laboratory.

5. Set aside land for future mixed-use development.

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A Landscape Master Plan for Fisherville Mill

Grafton, MA 01560

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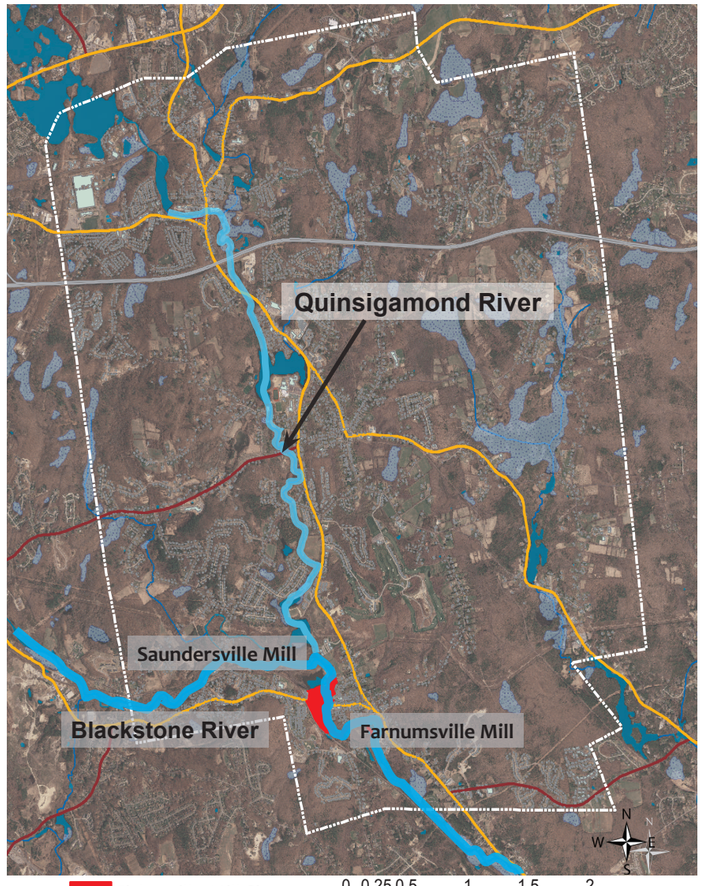
Context

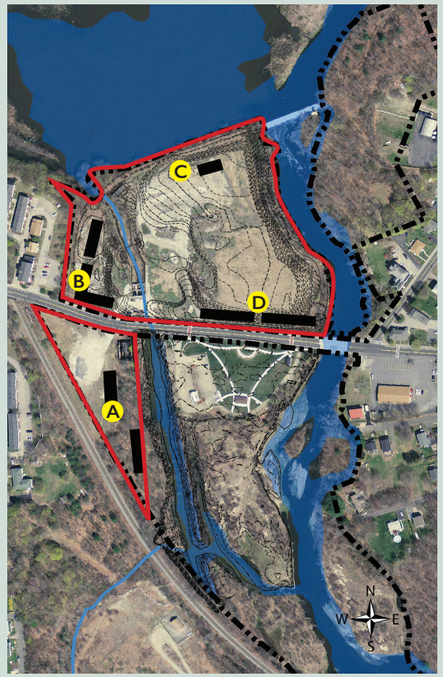
The town of Grafton is located 30 miles west of Boston, and 5 miles southeast of Worcester. The entire town is within the Blackstone River Valley National Heritage Corridor. The Fisherville Mill site is located in the village of Fisherville in South Grafton, just downstream of the confluence of the Blackstone River and the Quinsigamond River, which is at the northern extent of the Fisherville Pond.



The Blackstone River National Heritage Corridor stretches from Worcester, MA to Providence, RI along the Blackstone River and its tributaries. It encompasses 25 cities and towns including Grafton. Its geology and hydrology make the Blackstone River exceptional for hydropower. Although only 43 miles long, the river drops over 400 feet in that distance. At its peak, the river had roughly one mill per mile, and South Grafton alone had three mills. Its ability to power so many mills made the Blackstone River Valley the birthplace of the American Industrial Revolution.

Although the Industrial Revolution brought great prosperity, it inflicted a huge amount of environmental degradation as land was cleared and toxins were dumped directly onto the land and into the river. In addition, due to lack of fire safety standards and large amounts of cotton in the air, many mills burned down. This released additional toxins into the air, soil, groundwater, and eventually into the sensitive rivers. This was repeated many times throughout the region, including twice on the Fisherville Mill property. After many years, the quality of the Blackstone River improved due to land use changes, and the formation of the Environmental Protection Agency and the Clean Water Act. The river is now the cleanest it has been in over 150 years and is a great recreational resource. People can now fish and swim in the river, though the bottom sediments are still contaminated and fish should not be eaten.

Although the Blackstone River's history is mainly industrial, the river's ecology adds to the site's context.



One of the driving forces for the project is the future development of the property. The areas outlined in red are for sale and are intended to be mixed-use development. The black boxes indicate the client's desire for buildings and their relative placement. The land around the two westernmost buildings at location labeled "A" has been preapproved for residential development. The client has also expressed a desire for 200 residential units on the northern parcel. Each unit would require 1.25 parking spots. There are no current plans to develop locations B, C, or D.

Though these potential structures are kept in mind throughout the creation of this plan, they are not an explicit part of the design. The focus of this document is on creating a teaching landscape and a place for people to recreate and gather. The designs do not incorporate these future buildings, but establish a context for them.

The step dam at Fisherville impounded the water that powered the Fisherville Mill at one time through the Blackstone Canal.

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Context

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History of the Fisherville Mill Site

When the mills of Blackstone River were still functioning it was considered one of the hardest working rivers in America, and was one of the centers of the American Industrial Revolution. As a result, the region's development centered around this river and the industries that used it. The era of the great textile mills of the Blackstone Valley lasted from the early 1800s to the mid-1900s. Three mills were built in South Grafton: Fisherville, Farnumsville, and Saundersville. The Fisherville Mill produced mainly textiles from the time of construction until the mill closed during the Depression.

Industry

1793 The Slater Mill is the first mill in the Blackstone River Valley.

1827 Farnumsville is the first mill to open in South Grafton.

1831 Fisherville Mill is built, and is the only mill in town to use the canal for hydropower.

1881 After several expansions, Fisherville Mill burns down and is rebuilt and expanded.

1930 Fisherville Mill and many others in the Valley closed due to the Depression.

1941 Mill re-opens during WWII producing nylon for parachutes

1980 Several manufacturing companies occupy the building until it is left abandoned.

1999 Mill destroyed by fire; arson suspected.

2000-present EPA begins remediation of one hundred years of toxins in the air, water, and soil.

Future

The site emerges from past degradation to be an example for alternative remedial technologies, and the positive reuse of brownfields

Transportation

pre 1823 Overland travel on poor roads is the predominant means of travel.

1828 Construction of the canal is completed, making travel between Worcester and Providence possible.

1835 Boston to Worcester Railroad is completed.

1847 Worcester to Providence rail that parallels the canal is completed.

1848 Blackstone Canal closed, its functions replaced by rail line.

around 1940 Track and auto travel begins to overtake rail travel.

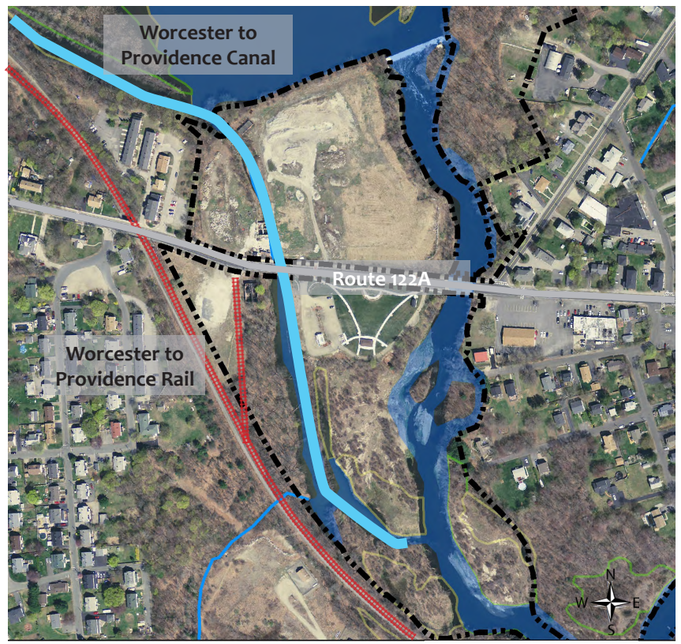
A walkable, bikeable community emerges that is less reliant on cars to access green spaces.

Social Past Carrying to the Present

Nipmucs were the first people to inhabit the Blackstone River Valley. Today, many residents are descendants of the Europeans who immigrated to work in mills. Irish immigration to the area started with a strong influx of skilled canal builders helping to build the Blackstone Canal. After the railroad was introduced in 1847, the canal ceased operating. Grafton's population had increased dramatically by mid-century, almost tripling as manufacturing grew. Irish, French Canadian, English and Scottish immigrants settled in the town. Residential, institutional, and commercial development continued in Grafton Center while the industrial hubs also grew.

Mill owners and other wealthy residents lived in Grafton Center, while the poorer mill workers lived by the mills in the south. This historical separation of wealth continues today with South Grafton having lower median income than Grafton Center and North Grafton. The client hopes to create a great place to bring these two populations together.

Mill owners recruited primarily French Canadians and Polish immigrants to work in the mill. Many descendants of these workers still live in South Grafton.



Multiple modes of transportation, water, rail and car, traverse the property.

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History of Fisherville Mill

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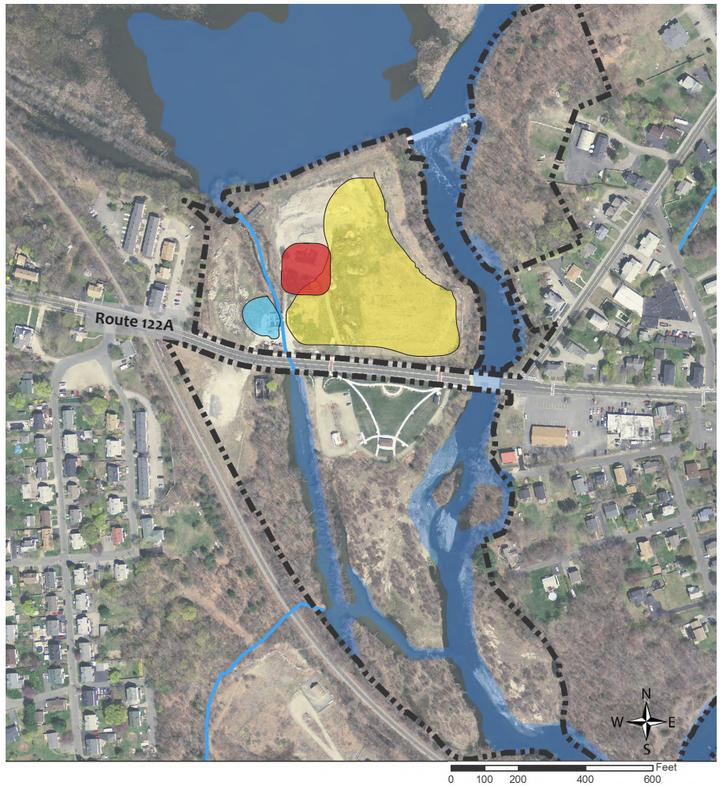
Remediation

The site's long history of pollution and degradation reached its peak in 1999 when the abandoned mill burned down. The fire released over 100 years worth of contaminants and pollutants of different types into the air, soil, and water. Since then there have been considerable and successful efforts, both public and private, to remove contaminants from the site.



Oil pollution source

TCE pollution source

Capped Brownfield

Contaminants Found on Site

- Asbestos is a naturally occurring fibrous material that was often used as insulation and a fire retardant. It is dangerous to humans when airborne and inhaled, and has been linked to a number of lung and respiratory health conditions.
- Lead is a naturally occurring element that causes a myriad of health problems in humans, especially children, and is now strictly regulated. It was used in paint, gasoline, pipes and plumbing, and ceramics.
- #6 oil is the residual oil remaining when more valuable oils have been separated. It is the most viscous fuel oil, often used for heating. It has been shown to affect human immune system, reproductive system, nervous system, endocrine system.
- TCE is an industrial solvent and degreaser that is known to cause cancer, as well as other health issues.

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Post-fire Cleanup

Contamination on the site was limited to the north parcel, mostly occurring east of the canal where the mill building once stood. Contaminants on the northern site included asbestos, different oils, Trichloroethyylene (TCE) (cleaning solvent), and heavy metals. These contaminants came from different sources, requiring different remediation techniques outlined below. Parcels south of 122A were contaminated by TCEs through the flow of groundwater.

A scientist collects samples from the northern parcel for testing.

Oil

Preceding the fire, oil was a major contaminant and the mill's two 20,000-gallon oil tanks had been leaking into the ground and canal beginning in the 1970s. The EPA ordered the removal of the tanks in 1990 and though they were removed, residual oil in the soils and groundwater continues to contaminate the canal water and sediments. As there was need for continued remediation, several techniques were initiated with EPA grants. A concrete structure was placed in the oil release area to prevent further surface water and sediment contamination. Inside this structure is an oil skimmer that removes and collects oil as needed. In addition, an eco-machine was built to filter the canal water using biological methods (explained further on the following sheet).

This photo from 2003 shows the extent of the oil contamination in the Blackstone Canal.

Asbestos and Lead

Asbestos became a primary concern after the mill was destroyed by fire, which released asbestos into the air and contaminated all the rubble on the northern property, between the canal and the river. An EPA emergency response team tested the area and removed contaminated material. Lead was also found after the fire and was removed along with the asbestos. Between lead and asbestos, 7,000 tons of contaminated debris were removed in 2000. Additionally, since Massachusetts considers all materials exposed to asbestos to be asbestos bearing, the site needed additional action. The area was then capped with fourteen feet of fill in 2004 to prevent any exposure.

Northern parcel was capped with flowable fill to contain toxins.

TCE

TCE and other cleaning solvents were found at very low levels in the Town drinking water wells southwest of the canal directly after the fire in 1999. The contamination was found in groundwater on the northern site, but also under the current Mill Villages Park. Several remediation techniques have been used to prevent future contamination of the well using both chemical and physical methods. The TCE remediation involved on site chemical oxidation where an oxidizing compound is pumped in the groundwater, destroying TCE compounds. A hydrologic study completed in 2002 showed that the water flowed away from the well, and it was decided to place a dam where the canal meets the river to increase the hydrological gradient towards the river, and thus, increase groundwater flow away from the public well.

Chemical holding tanks pump oxidizing agent into contaminated soils

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REMEDIATION

HILLARY COLLINS,
JILLIAN FERGUSON, AND JEFF FRISCH JR.

SPRING 2015

Living Systems Laboratory

One of the greatest educational assets on the property is the Living Systems Laboratory, a biological system to remediate oil and other contaminants in the Blackstone Canal. It combines the purification powers of a wetland with the ability of fungi to break down hydrocarbons to reverse years of abuse.

The Living Systems Laboratory is a pioneering technology that uses biological processes for filtration that is conventionally done with chemical or mechanical methods. It was created in collaboration with John Todd Ecological Design and Paul Stamets to remove #6 fuel oil, a legacy pollutant, from the water. The whole system consists of a microbial "Bottom Filter," a greenhouse that includes myco-reactors and aquatic cells, and the canal restorer, a floating vegetative raft. Each of these is an important part of the system that according to Gene Bernat removes 90% of the total hydrocarbons in the water. Through natural selection, the living eco-machine will adapt to the input of contaminants, and evolve to increase efficiency. The model below shows the flow of water through the system with arrows representing direction of flow and relative cleanliness of water with the lightest blue being the cleanest.

The Living Laboratory Systems is lush and green and offers a valuable interpretive and teaching tool. Visitors can learn how ecosystems function through the aquatic cells and myco-reactors; the importance of ecosystem services that wetlands provide; and glimpse into what the future can hold as alternative, regenerative technologies replace mechanical ones. The client would like to expand and relocate the LSL to increase its filtration capacity.

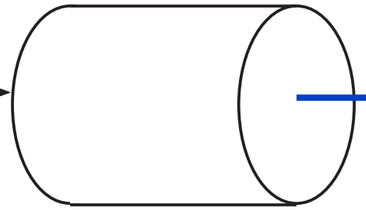
Greenhouse

Myco-Reactors

The canal water enters the myco-reactors in the greenhouse. In these bins sawdust inoculated with mushrooms are able to break down hydrocarbons and other pollutants into non-toxic elements. The water then goes to the aquatic cells.

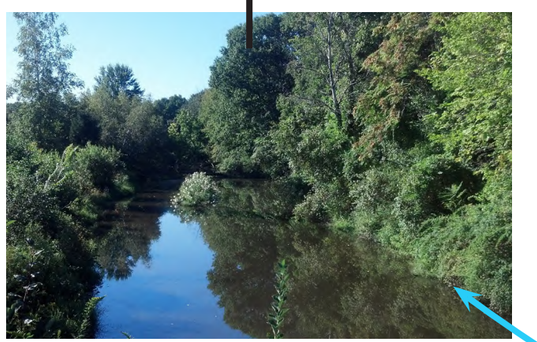
Aquatic Cells

The aquatic cells are simulated wetlands consisting of six 700-gallon tanks able to harbor complex ecosystems that include all kingdoms of life. The plant roots are especially important for uptake of heavy metals, and to provide colonization surfaces for microbes. The water passes through a clarifier to settle out any sediments, and is then pumped out of the greenhouse to the canal restorer.



Bottom Filters

Microbial life in the filters on the bed of the canal begin removing contaminants from the water. Some water goes directly to the canal restorers and the rest goes to the myco-reactors.

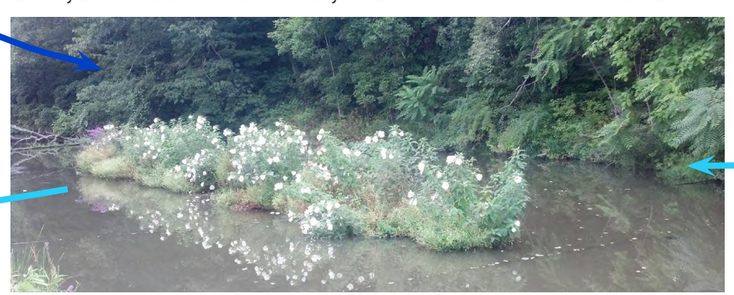


Canal Water

Though visibly less polluted by oil than it once was, the canal still accumulates oil that leaches from the soil and groundwater. Thus, ongoing cleanup is needed.

Canal Restorer

Water is pumped to sprinklers on the vegetated floating rafts in the canal. The roots of the native plants extend into the water column, which filter water and provide habitat for helpful organisms coming from the eco-machine, and those already in the canal. The substantially cleaner water then enters the canal.



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Living Systems Laboratory

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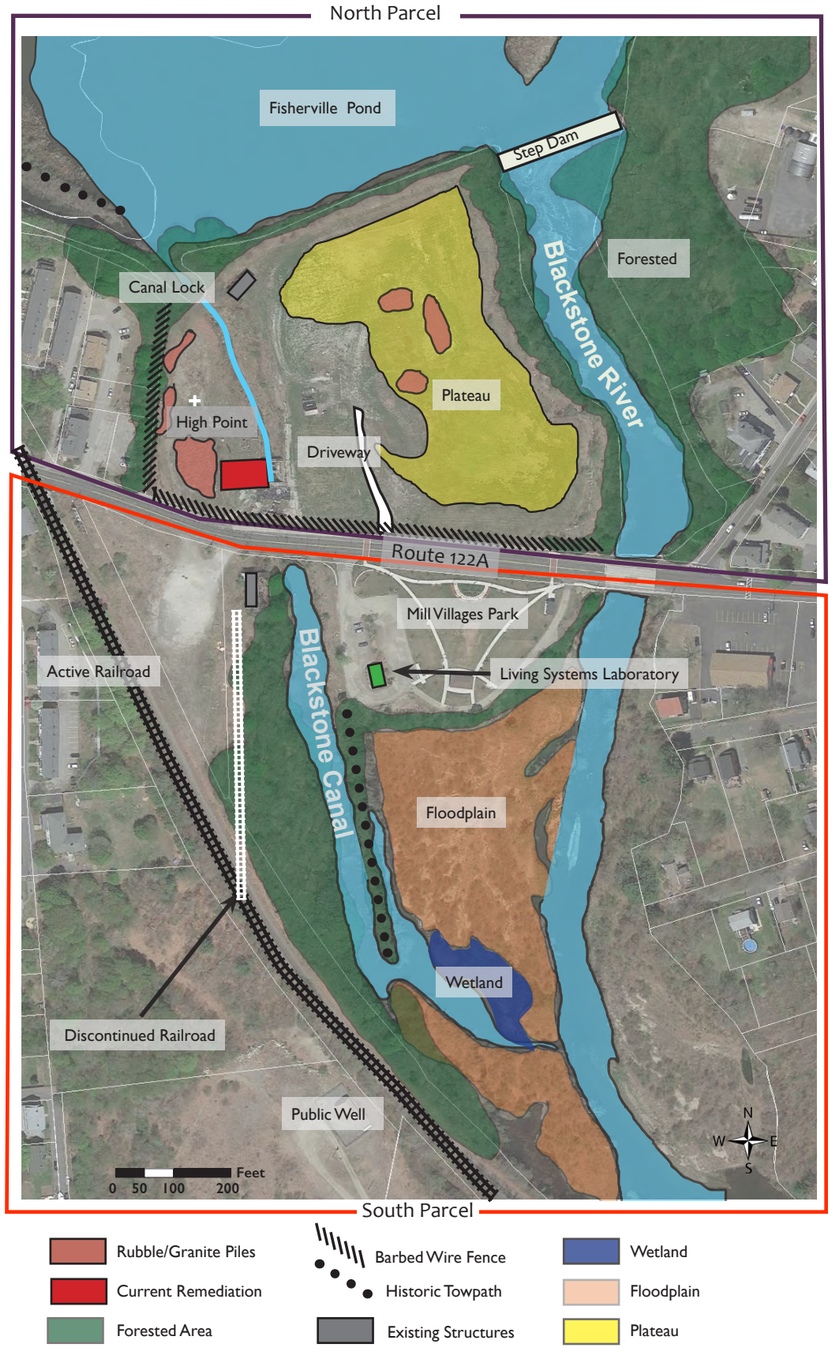
Existing Conditions

The land has been sculpted by human forces and the topography, hydrology, and vegetative patterns are almost entirely man made. Despite human influence, places of natural integrity and beauty still exist. Route 122A bisects the project site. The northern parcel has experienced heavy industrial uses and contamination, while the southern is less disturbed.



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Northern Parcel

- The industrial past and its remediation have shaped the northern parcel. It has several flat areas including a plateau above the capped area, as well as many steep slopes down to the river on the eastern side, and the canal on the western side.
- Two waterways divide the northern parcel into three sections a 1.25-acre section west of the canal, a central 7.6-acre portion, and a 4.8-acre forested section east of the river.
- Along the Blackstone River and Fisherville Pond, riparian trees and other vegetation grow; some of the trees are quite mature, indicating that the banks have been less disturbed than the rest of the parcel.
- Many remnants of the industrial past, including locks and a spillway, show how the site was used for transportation and power production. The canal is highly visible from its banks but there is no access to the water.
- Where the canal meets the pond there is a historic lock that limits the flow of water into the canal. Northwest of this lock is the overgrown towpath that the client envisions as a pedestrian connection northwest to Saundersville.
- There is an abandoned electrical substation in the northwest of the property that is empty and in disrepair.
- A step dam between the central and western portions of the parcel creates a cascading waterfall that can be seen and heard from many areas of the property.
- The plateau is surrounded by slopes above 15% on most sides. It is vegetated largely by herbaceous species. Soils are compacted and stony. The steep slopes surrounding the plateau have a thick herbaceous cover with some shrubs and trees on the east, north, and south. The steep slopes on the west of the plateau are more sparsely vegetated.
- West of the canal is the highest point on the property, which has views of the canal, the pond, and the river in the distance. It is currently the storage place for granite rubble piles that used to be part of the mill's foundation.
- An unattractive barbed wire fence blocks access from the road to the north property.
- Though most of the former contaminants have been remediated, oil still seeps into the canal where the fuel tanks for the mill were. An oil skimmer helps remove some of this oil.
- The current entrance driveway is rarely used and lined by steep slopes.

With the fourteen feet of fill now on the northern parcel, more views are available. Hilltops frame the southwest view from the top of the cap.

Southern Parcel

- The southern parcel has sections of low and high human impact, but nothing as detrimental as on the northern parcel.
- Mill Villages Park, just south of Route 122A , and the western portion of the parcel between the active railroad and the historic railroad show the greatest impact.
- An abandoned Agway building sits at the northernmost part of the historic railroad.
- Another section of the historic towpath lies between the canal and the floodplain.
- The Blackstone Canal is much deeper here than in the northern property. It contains a canal restorer along with vegetated and non-vegetated oil booms that passively remove oil from the water.
- The Living Systems Laboratory is located to the west of the Mill Villages Park within a thirty-car parking lot.
- Some relatively undisturbed forest areas grows on the slopes surrounding the canal and in the floodplain. The canal is lined with a dense riparian woodland that has grown over the historic towpath.
- The floodplain has sandy soils and a mid-successional forest. There is also a marsh in the southwest portion of the floodplain.
- The Blackstone River lies to the east of the floodplain. There are steep slopes at the river edge that have eroded.

Mill Villages Park includes a pavilion that is used occasionally for concerts in the warmer months and the Living Systems Laboratory adjacent to the canal is an educational resource for visitors.

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Existing Conditions

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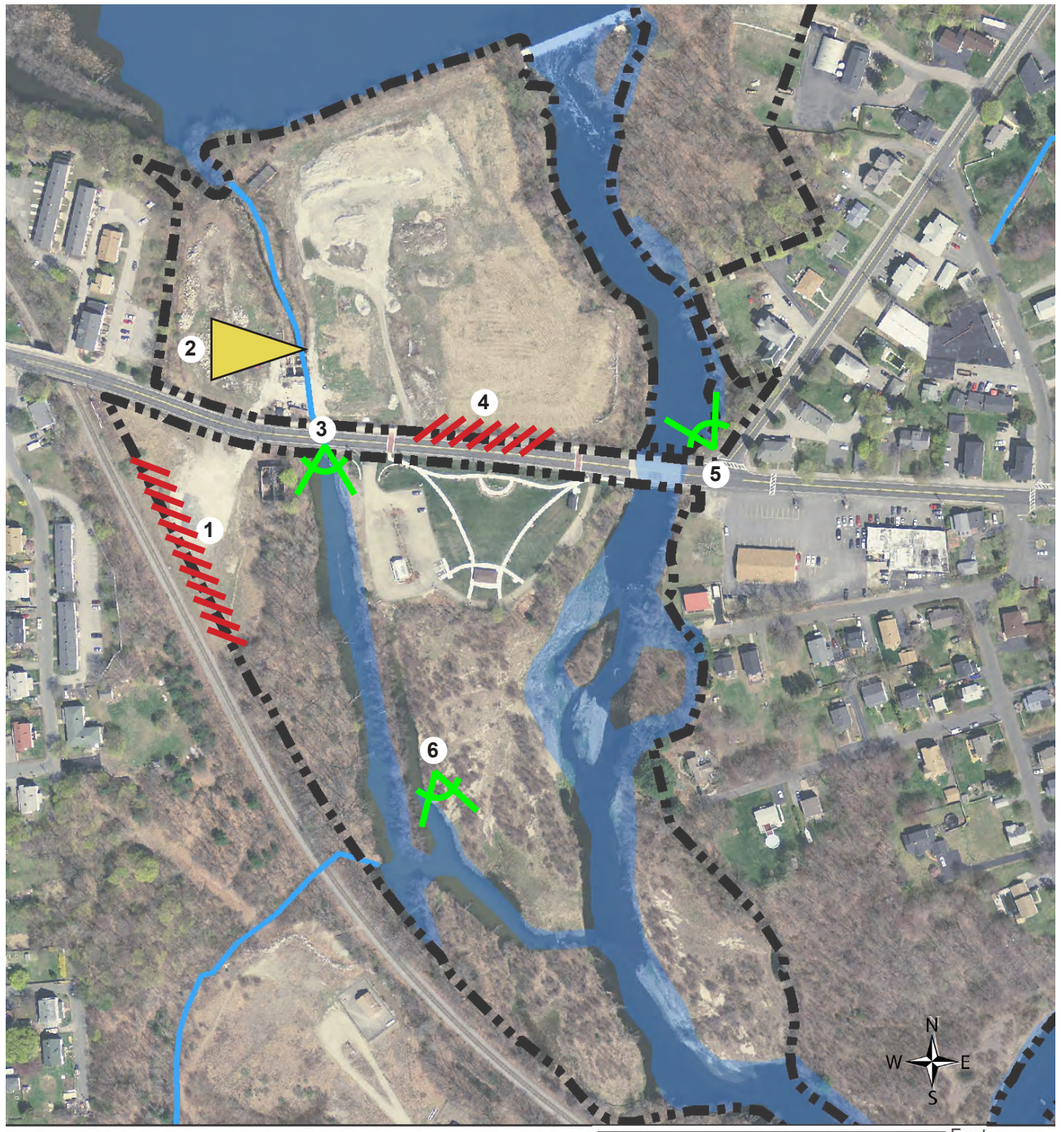
Views Analysis

Many areas at the Fisherville Mill site have both beautiful views as well as unfavorable views. When siting a trail, it is important to highlight the beautiful places on the property to create a desirable park destination. Design elements could ameliorate or screen unattractive vistas.



Legend

- Unfavorable View
- Favorable View
- Blocked View

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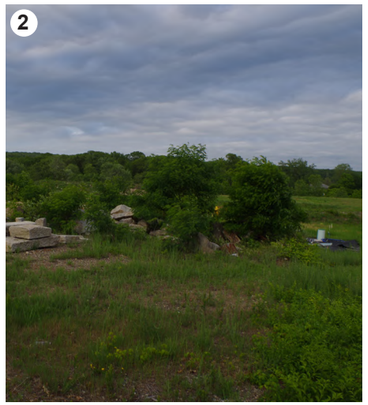
Hilary Collins

The active railroad on the western parcel south of Route 122A is one of the few unfavorable views on the property. This parcel is preapproved for residential development. An active railroad could prove dangerous if there are no safety measures taken to keep people from getting too close to the railroad.

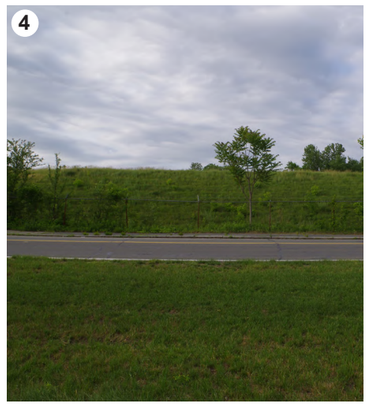


Jeff Frisch

On the western parcel north of Route 122A looking east, a potentially favorable view over the rest of the northern parcel is currently blocked by piles of granite blocks that once served as the foundation of the mill.

Jeff Frisch

An attractive view of the Blackstone Canal. Because the canal is currently being remediated by the Living Systems Laboratory, it provides a valuable opportunity for visitors to learn the canal's history and how the water is being remediated.



Jeff Frisch

View from the benches looking north from Mill Villages Park. The unfavorable view has potential to be a more attractive sight, drawing visitors into the park.

Jeff Frisch

From the east bank, there is a beautiful view of the waterfall, a potential trail destination.

Hillary Collins

The wetland is home to different species from the rest of the site and could be a place for future visitors to learn about wetlands, the services they provide and the various species that live within them.

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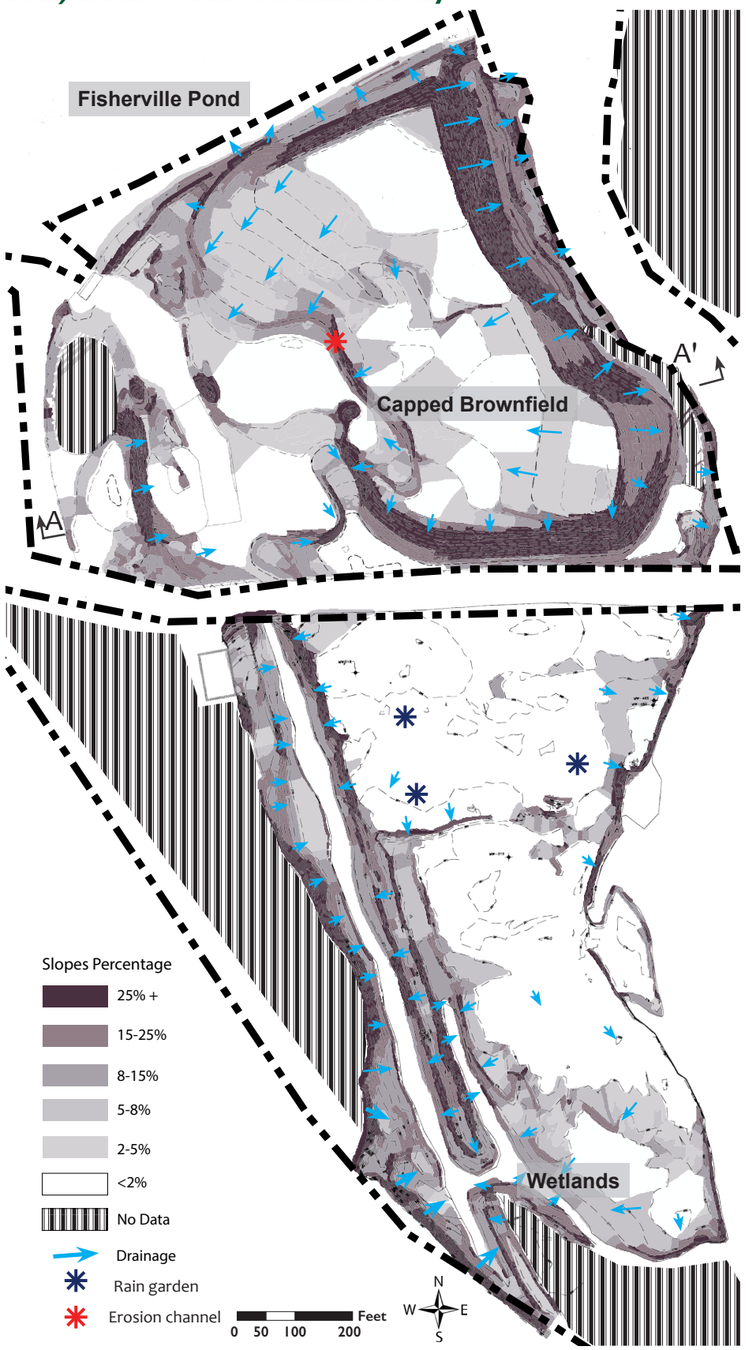
Slopes & Drainage

The site's broad flat areas are, in most cases, surrounded by slopes greater than 15%. A few of these steep slopes are due to the natural erosion caused by the Blackstone River. However, most of the steep slopes (and many of the flatter ones) are the result of human activity.



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Observations

Northern Parcel

- The slopes on the top of the capped section on the northern parcel are less than 5%, making the plateau relatively accessible.
- The plateau area is surrounded on most sides by slopes greater that 15%, not only making access difficult, but increasing the potential for erosion. Herbaceous plants growing on the steep slopes limit erosive forces.
- Access to the site from Route 122A is lined by steep slopes that limit potential access spots and channel water towards the road.
- On the river and road sides of the steep slopes, water is intercepted by a swale where it is conveyed east and infiltrated.
- Slopes down to the pond in the north, the Blackstone Canal, and the Blackstone River are very steep.
- Water on the plateau generally travels west and southwest towards the canal and the current entrance.
- An erosive channel is starting to form (indicated by the red star).

Southern Parcel

- Much of the center of the site is less than 2% slope, including the Mill Villages Park just south of the road and the floodplain in the southern half.
- Outside of these flat areas, slopes are steep and drain to the canal and river.
- The slopes down to the canal are unstable and above 8%, with most above 15%.
- The slopes along the western bank of the river are greater than 15% and are eroding.
- There are three rain gardens (labeled with blue stars) located around the site to manage runoff from the very flat Mill Villages Park.
- Water tends to flow south or towards the canal or river.

Implications

- Grading and/or vegetation will be needed to reduce erosion.
- The entrance to the property will need intervention to stop erosion from stormwater, and make it universally accessible.
- Slopes into the pond, river, and canal should be as vegetated as possible to lessen erosion.
- Steep slopes limit universal access to the plateau and trails will need to be on the few areas of shallow slopes, or traverse the contours.
- Keeping trails off steep slopes above 15% would help to reduce potential for erosion.
- Boardwalks along the river banks should be limited or kept inland to preserve the sensitive, erosive banks.
- Construction of a building or other structures should be kept to a minimum on slopes of the canal to prevent erosion.

General Slope Guidelines

Slopes less than 2% are poorly drained and can potentially form pools.

Slopes of less than 5% are considered universally accessible.

Slopes between 5% and 8% are accessible but require handrails and landings.

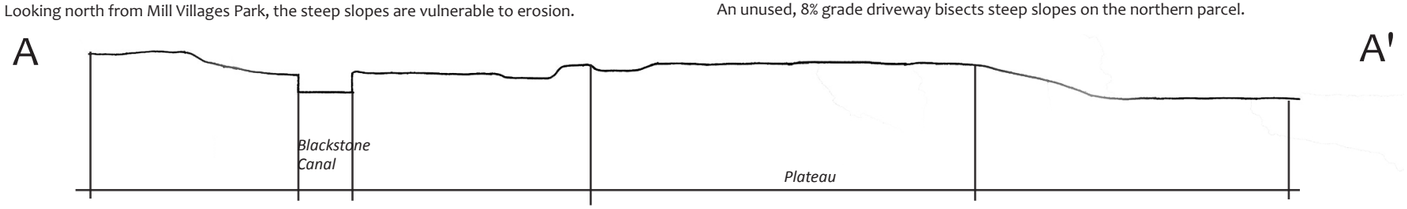
Slopes greater than 8% are a greater risk of erosion and should be vegetated or otherwise stabilized.

Jeff Frisch

Looking north from Mill Villages Park, the steep slopes are vulnerable to erosion.

Jeff Frisch

An unused, 8% grade driveway bisects steep slopes on the northern parcel.



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A Landscape Master Plan for Fisherville Mill

Grafton, MA 01560

Slopes & Drainage

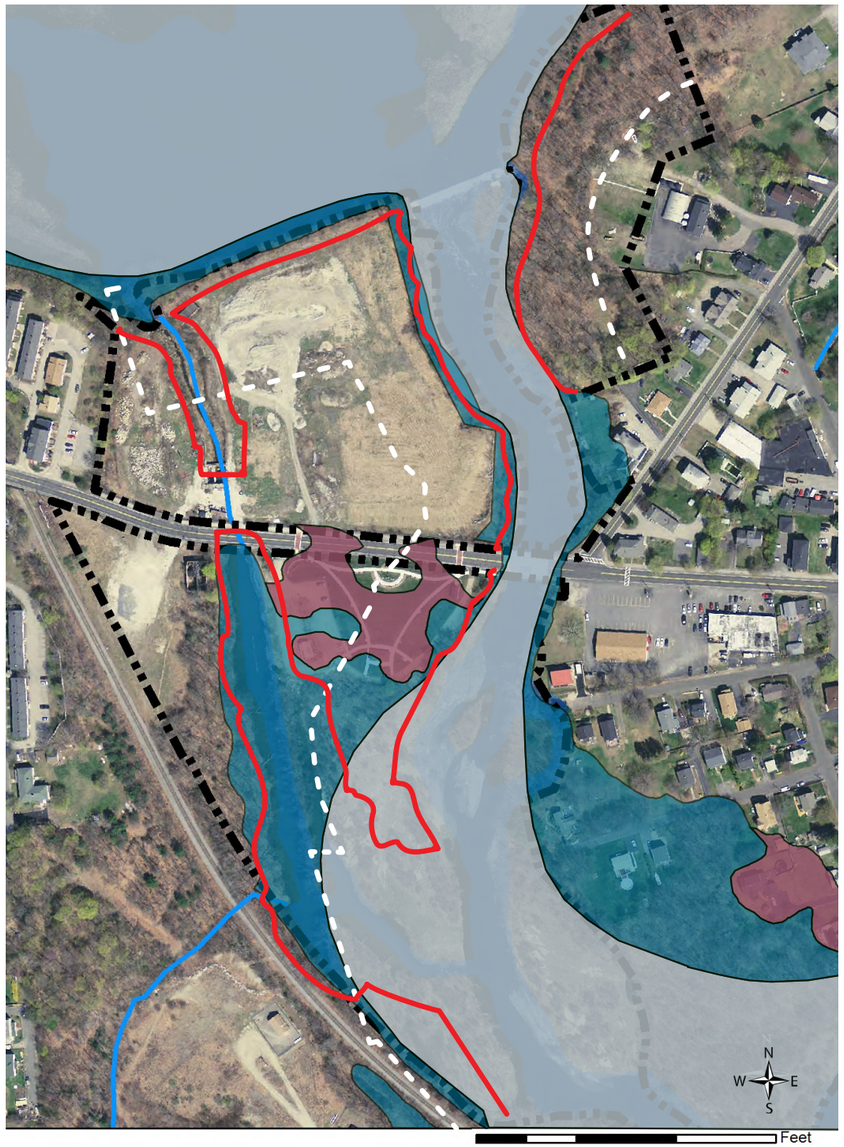
Hillary Collins, Jillian Ferguson, and Jeff Frisch Jr.

Spring 2015

8/30

Floodplain & Buffers

Due to the Blackstone River and Canal flowing through the site, it is subject to governmental regulations limiting certain uses and alterations. Though mapped below, the northern parcel has grandfathered exemptions due to the mill that used to be there. The Town's conservation commission would likely approve boardwalks and other trails in restricted areas if they allowed people to experience and learn about the natural environment.



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25' No Alteration Zone

This Massachusetts regulated area encompasses all areas within 25' of the canal and river. Alterations of any kind in this area are strictly prohibited.

Regulatory Floodway

A federal regulation, this represents the river and adjacent land areas needed to dissipate the base flood without raising the elevation of the water. In the southern parcel it covers around half of the floodplain. The north parcel is left unaffected except for some areas on the upper bank of the Blackstone River. Communities must regulate development in these floodways to ensure that there are no increases in upstream flood elevations.

500-year Flood

This represents the area flooded during storms that are statistically supposed to occur about every 500 years, or a .2% chance of annual flooding. Though the likelihood of these floods are small, they are projected to increase in frequency. Equipment or structures in these locations could be impacted.

200' River Front Protection Area

Areas within 200 feet of a perennial stream's or river's mean annual high water are protected by Massachusetts River Front Protection Act. Working in the 200' riverfront area is restricted and the applicant must show that there is no practicable alternative and that proposed work will not create a significant adverse impact on any of the interests of the river.

100-year Flood

This is the area that is inundated with water during 100-year storms, or that have a 1% annual chance of flooding. It covers all of the floodplain, the canal, and portions of mill villages park. The historic towpath is also covered. If an area is within the 100-year floodplain it is protected under the Massachusetts Wetlands Protection Act as well as the Federally restricted. The limits of the 100-year floodplain can be determined by consulting maps published by the Federal Emergency Management Agency (FEMA), although accounts of observations of flooding can in some cases be used as evidence also.

Mass DEP

The usually dry floodplain shown here under a few feet of water.

Mass DEP

Large influxes of water can increase the amount of oil that escapes into the canal.

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Floodplain & Buffers

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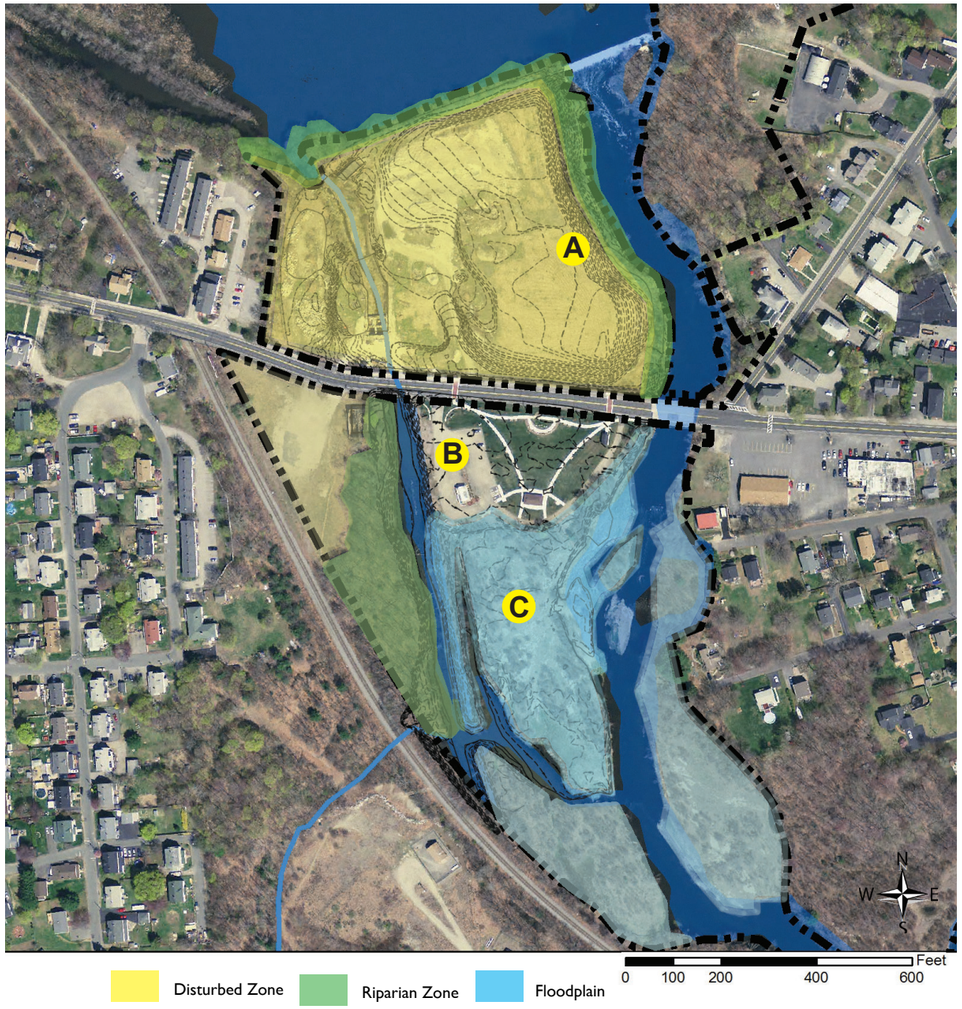
Vegetation Analysis

Due to the site's dynamic landscape with a floodplain in the southern parcel, a man-made park, and the unmanaged northern parcel, there is a great diversity of vegetation in each area.



	Observations	Implications
Disturbed Zone	Grasses such as native *Conyza canadensis* (horseweed) grow in abundance. Invasives such as *Ailanthus altissima* (tree of heaven) take advantage of this highly disturbed area.	Due to the particular species and invasive management plan will be less labor intensive within highly impacted areas. Because most invasive species are within concentrated areas, they can likely be managed with hand cutting methods. Due to the great depth of fill over the cap (14 feet), deeply rooted trees may be allowed to establish.
Riparian Zone	A mature forest provides a riparian edge around the north parcel, adjacent to the Fisherville Mill pond. This forest provides habitat for many bird species such as kingfishers, green heron, cormorants and great blue herons. The canopy consists of *Populus deltoides* (cottonwood), *Quercus coccinea* (scarlet oak) and *Acer saccharinum* (silver maple) that also assist in stabilizing the bank. Invasives such as *Phragmites* (common reed) and *Lythrum salicaria* (purple loosestrife) inhabit the edge of Fisherville Mill Pond and the river; however, these species do help stabilize the banks.	There is an opportunity to add meadow species to the open space within the northern parcel. A meadow would require less maintenance while keeping open possibilities for future ownership and development. However, the *Phragmites* and *Lythrum salicaria* thriving around Fisherville Mill Pond will require more demanding methods of eradication, due to their pervasive natures. Removing these species will leave the banks unstable. Therefore stabilization and revegetation plans must be in place prior to removal.
Floodplain	In this floodplain, *Acer sacharinum* (silver maple), *Betula nigra* (river birch), and *Rhus glabra* (smooth sumac) are the dominant species.	The early successional floodplain can offer interpretive opportunities by highlighting this compelling and changeable landscape. A diversely vegetated floodplain maintains resilience, creates an array of habitats, and helps to control erosion along the banks.

Jillian Ferguson

*A young stand of the exotic and expansive **Ailanthus altissima** inhabits the disturbed slopes on the northern parcel.*

Jillian Ferguson

A view across the Blackstone Canal to vegetation consisting of more mature trees and riparian species.

Jillian Ferguson

The floodplain forest in the south consists of young shrubs and trees. Due to the nature of a floodplain, the vegetation occasionally suffers disruption and renewal.

Invasive Plant Management

Invasive species management is a complex issue that requires comprehensive knowledge, intensive labor and monitoring. Further research should be done before dealing with the *Ailanthus altissima, Phragmites* and *Lythrum salicaria*. All of these species spread by seeds, but the *Ailanthus altissima* and the *Phragmites* also spread by resprouting. Because these species can spread quickly and easily, they may be more challenging to eradicate. It is worth noting that other highly invasive species, like Japanese knotweed, have not been introduced to the site, but once they are established they are extremely difficult to eradicate fully. Early intervention with species like knotweed is crucial. The *Phragmites* and *Lythrum salicaria* could be managed and removed, however costs can be prohibitively high. After an intensive bio-survey is conducted, a management plan with clear priorities should be proposed.

***Ailanthus altissima* Management:**

Mechanical Methods:

Digging and cutting are appropriate for controlling smaller, younger stands of *Ailantus altissima*, especially in environmentally sensitive areas. The entire plant, including roots and runners, must be removed with a digging tool. With cutting, the shoots must be cut as close to the ground as possible, and cutting is most effective when done three or more times per growing season. The cut plant parts must be bagged and disposed of properly to prevent further spreading.

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Vegetation Analysis

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Spring 2015

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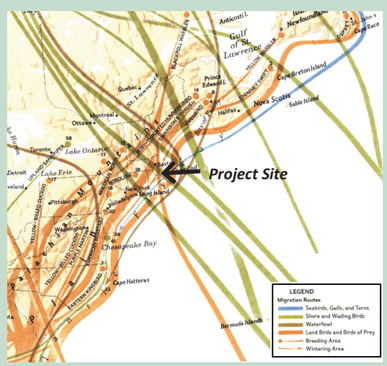
Wildlife Analysis

The site's various ecosystems create a wide range of habitat for different wildlife. Areas on site that are more densely vegetated and structurally diverse provide better habitat for a larger number of species.

	Observations	Implications
Fisherville Pond	The Fisherville Mill Pond and its surrounding vegetated banks are active bird areas. The pond is located in the Atlantic flyway (see below).	Allowing visitors to access the northern parcel and the Fisherville Mill Pond's edge will provide an opportunity for birding.
Disturbed Zone	Due to lack of vegetation most of the highly disturbed northern parcel lacks habitat for bird and animal species including pollinators. The forested edge of the river is a corridor for birds and mammals.	Introducing a habitat for birds within the highly disturbed, open space on the north parcel with meadow grasses, and supplementary trees and shrubs will engage visitors and could provide an interpretive opportunity with signs educating visitors about bird habitat and migration.
Blackstone Canal	The aquatic habitat of the canal within the southern parcel is filled with high concentrations of insect life, minnows, carp, snapping turtles, painted turtles, amphibians and muskrats. These species indicate the canal's improved health. The floating canal restorers create pockets of oxygenated water that attracts amphibians, which are especially sensitive to water quality.	Along accessible sections of the canal, interpretive signs about indicator species and eco-system health could be placed. The vegetated oil booms and canal restorers that currently remediate the canal can offer an abundance of biological and ecological instruction.
Floodplain	Snapping turtles and beavers populate the floodplain. There are currently signs at the entrance of the floodplain warning visitors of the presence of snapping turtles. Gnawed-off tree trunks throughout the floodplain indicate the beavers' presence.	Future access through the floodplain should be planned with habitat in mind, providing enough habitat within the floodplain for beavers and snapping turtle.



http://andrewswoods.org/

The project site is withing the Atlantic Flyway.

Atlantic Flyway

There are thirty-two priority bird species within the Atlantic Flyway from Canada to South America. These are species that are targeted for extra conservation efforts to ensure their continued survival. Many of these bird species frequent the coast and wetlands of northern Massachusetts.

The Massachusetts Audubon has a wildlife sanctuary in Worcester, dedicated to land conservation practices supporting migratory bird habitats. Collaborating with the Audubon Society could provide an opportunity to build habitat at the FIsherville Mill that supports priority bird species, such as the grasshopper sparrow, a threatened species in this area. The grasshopper sparrow typically breeds in grassland, upland meadows, pastures, hayfields, and old field habitats, favoring open areas.

Providing habitat for the grasshopper sparrow (Ammodramus savannarum), a priority bird species, would aid this threatened species.

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Wildlife Analysis

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Jillian Ferguson, and Jeff Frisch jr.

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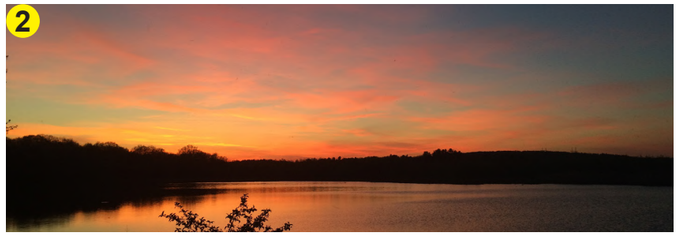
Natural & Historical Inventory

The 32-acre site offers a wide variety of natural and historical features that visitors will be able to interact with and learn about. From the southern floodplain to the northern riparian boarder along the Fisherville Pond, this dynamic landscape tells the story of human manipulation and disturbance, as well as natural processes involved in remediation. These photos illustrate potential destinations along future interpretive trail system.

Jeff Frisch

A step dam was built in the early days of the mill, and provides a beautiful destination along the trail for visitors.



Hillary Collins

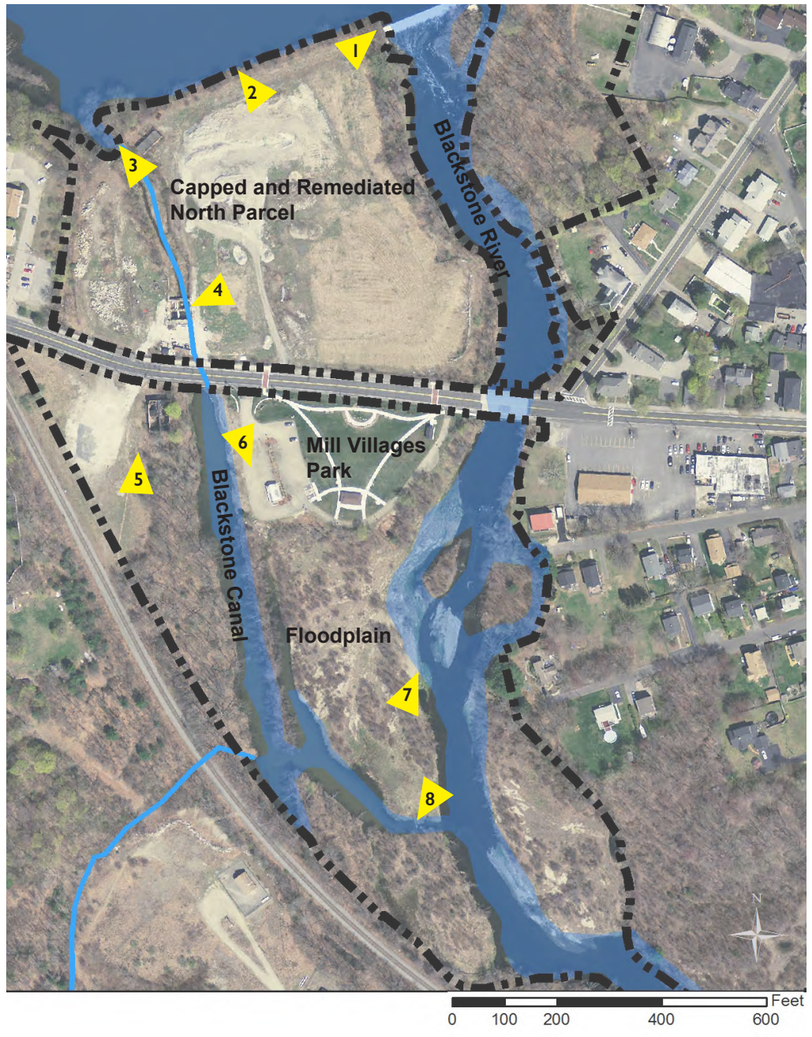
The northern bank overlooks the Fisherville Pond flyway, providing future visitors a view of various species of birds and a beautiful landscape.

Hillary Collins

The canal's locks demonstrate how water was diverted to power the Fisherville Mill.

Jeff Frisch

Further south along the canal, an oil skimmer continues to remediate the on-going seepage that has contaminated the canal.



Hillary Collins

Abandoned railroad tracks parallel to the Blackstone Canal create a window into the past.

Jeff Frisch

The Living Systems Laboratory uses biological processes to filter the oil that seeps from the residual oil in the soils and groundwater on the north parcel.

Jeff Frisch

The floodplain forest in the south of the property offers a contrast to the barren northern parcel.

Living Systems laboratory

The Blackstone Canal converges with the Blackstone River at the southernmost point of the floodplain at a spillway. This destination provides further education about remediation of the Blackstone Canal.

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Natural & Historic Inventory

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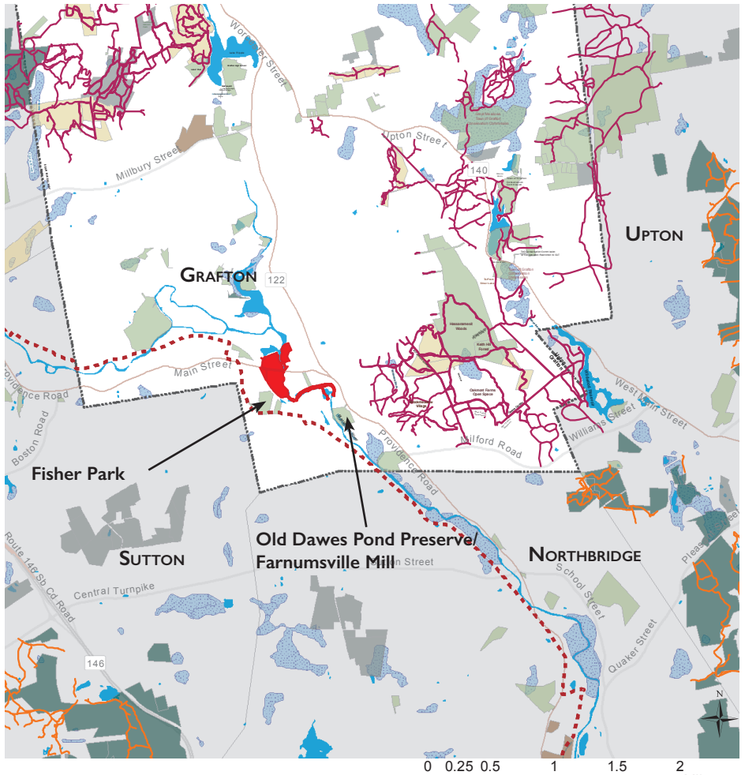
Existing Trails & Open Space

Grafton has more than forty miles of trails. There are no trails in the southwest corner where the Fisherville Mill site is located. There is ample opportunity for outdoor recreation including fishing, horseback riding, hunting, canoeing, kayaking, biking, and swimming in the various open spaces of the town. Trails and the creation of more open space on the Fisherville Mill site could contribute to pedestrian and recreational connectivity within Grafton and with neighboring towns.



Observations

- The site is in the southwest corner of the town and is largely unserved by trails.
- None of the town's trail networks connect with the site.
- Most of the trails are within the eastern portion and the northwestern portion of Grafton and extending into neighboring towns.
- The proposed Blackstone River Greenway will run less than a quarter-mile southwest of the Fisherville Mill site.
- There are various town open spaces within a quarter-mile of the site, including Fisher Park, an active recreational park to the southwest of the Fisherville Mill site.
- The Farnumsville Mill and Old Dawes Pond Preserve are located to the south along the river. Sutton and Northbridge do not have trail networks or open spaces that are close enough for connections.
- The closest trail network to the Fisherville Mill site is just over a half-mile to the southeast. The trails travel through open spaces, neighborhoods, and connects to the trails along the eastern border of the town.

greatergrafton.com

Providing better connections to Fisher Park could draw a wider demographic to Fisherville Mill.

Implications

- The Fisherville Mill site could potentially connect to three nearby places of interest including the Fisher Park, which is within a quarter-mile, and the Farnumsville Mill and Old Dawes Pond Preserve, which are just under a half-mile from Fisherville Mill.
- The Farnumsville Mill also represents the industrial past of Grafton and could incorporated into the interpretive trail system via a trail extension.
- The Blackstone River Greenway proposed by the Blackstone Heritage Corridor, spans forty-eight miles from Worcester to Providence and is within a quarter-mile of the Fisherville Mill site. A trail network in the Fisherville Mill site could be a spur off of the main bikeway to create a regional connection and valuable resource for bikers interested in learning about the canal.
- The nearby trails in the southeast corner of Grafton offer the potential for a connection to the town's forty-plus miles of trails.
- Each of these connections would achieve the goal of regional connectivity and drawing large numbers of people to explore the historical, biological, and social layers of the site.

waymarking.com

The Farnumsville Mill, a half-mile south of Fisherville, shares its industrial history.

Blackstone River Greenway

The Blackstone River Greenway is a 48-mile-long bike trail connecting Worcester to Providence, Rhode Island. It will travel along the Blackstone River or the canal where possible. The Greenway project is still under construction. Fifteen miles of the trail have been built, mostly in Rhode Island. Because the section near the Fisherville Mill is still in the planning stages, now would be the prime time to link the Greenway to the Fisherville Mill site. An existing temporary trail along streets in Grafton provides users with scenery and history of the Blackstone River and canal.

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Trails & Open Space

Hillary Collins,
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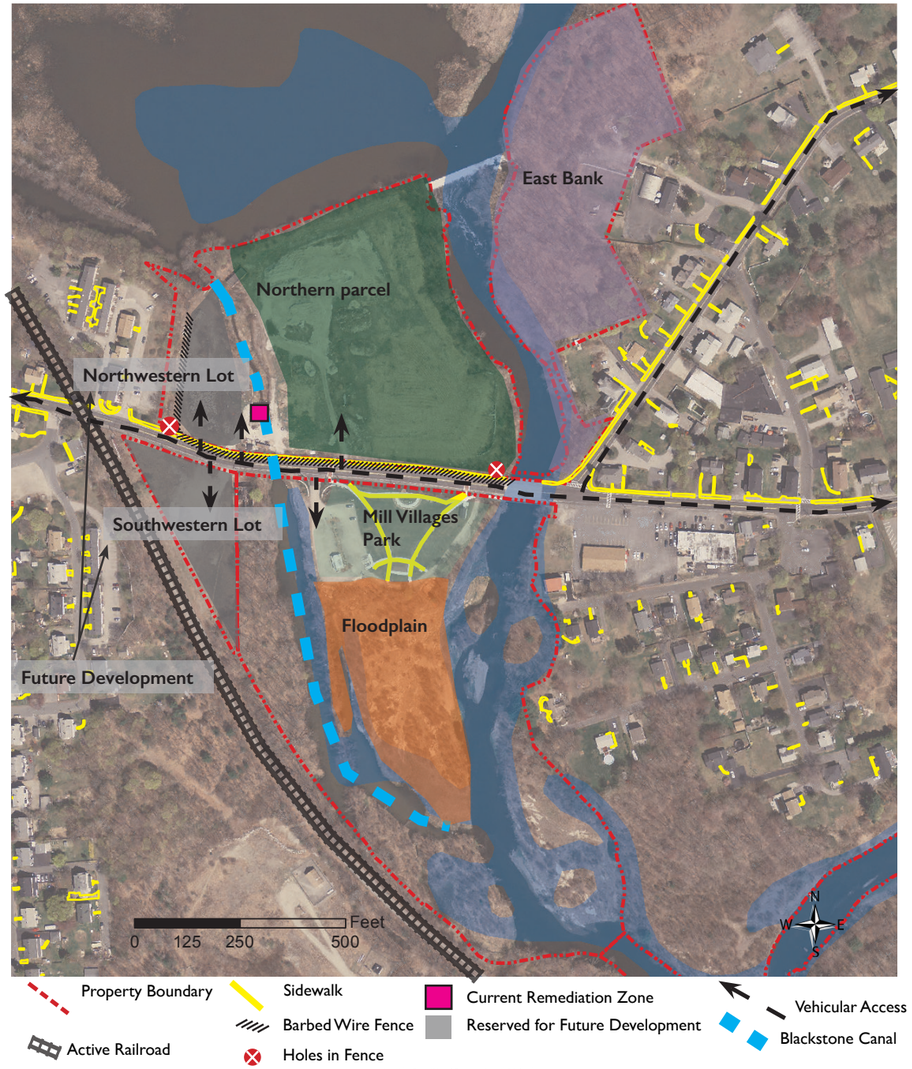
Spring 2015

Access and Circulation & Existing Land Use

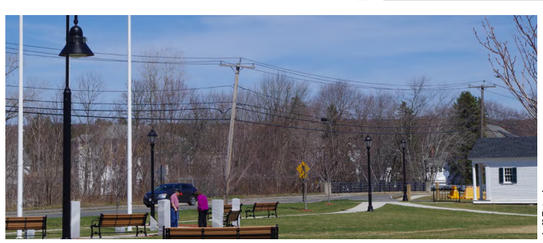
The Fisherville Mill site is bisected by Main Street/122A, which carries a high volume of cars between neighboring towns of Sutton and Upton. A sidewalk is only offered on the north side of the road, along a barbed wire fence overgrown with vines. Some pedestrians choose to walk on the south side of the street adjacent to the park, although it lacks a sidewalk. One of the client's goals is to connect the site to the larger community, and create an accessible space for the people in the nearby neighborhoods.



	Observations	Implications
East Bank	The eastern bank of the Blackstone River is one of the least used zones in the area. This six-acre riparian zone does not have direct access for pedestrians other than through the property of a private residence.	Designs could explore pedestrian access to the eastern bank, perhaps via a bridge.
North Center Site	Nine acres of the northern parcel of the property was once home to the old mill and has since been remediated. It is currently closed to the public and protected with a barbed wire fence. This zone of the property is less frequently used due to lack of access. However, holes in the barbed wire fence on both the east and west corners allow people to meander through the north parcel, where they've been observed gravitating towards the banks of both the Fisherville Pond and Blackstone River.	The remediation that has taken place on the northern parcel provides opportunities for future visitors to learn about the processes that took place. The banks of the pond and the river provide great views of the pond, the birds in the flyway, and the waterfall. A trail with interpretive signs along the banks could provide access and education.
Mill Villages Park	The two-acre Mill Villages Park on the south parcel has slopes under 5%. Sidewalks lead pedestrians into the park from the street. This is the area on the property most frequently visited, by both foot and vehicle. The parking lot provides space for roughly twenty-five cars, with two additional universally accessible spaces. The Living Systems Laboratory, located within the existing parking lot, draws people from all over the country and the world.	This zone creates a space of refuge for pedestrians walking along the street. The Living Systems Laboratory's remediation process is a valuable opportunity for future visitors to learn about forms of contemporary and future industry. The parking lot makes the park directly accessible to those traveling by vehicle, casting a wider net for potential visitors who may be traveling a distance. The addition of trees could help create a greener context as well as shade.
Floodplain	The floodplain is a 3.75-acre peninsula lined on the east by the Blackstone Canal and on the west by the Blackstone River, which has banks with slopes of 5%. Unmarked trails through the floodplain allow visitors to observe the various habitats and wildlife within the area. People naturally meander through the sparsely vegetated area. The river has caused erosion along the eastern bank of the floodplain.	The floodplain attracts visitors because of its dynamic landscape and rich habitat for wildlife. A raised boardwalk could bring visitors through the area with opportunities for education, but would need to be approved by the Conservation Commission. Slopes under 5% make it possible for a universally accessible path more attainable with minimal impact on the sensitive area. A raised boardwalk could reduce erosion along the bank and prevent future erosion by keeping visitors on the trail and not directly walking on the banks.
Future Development	The western portions north and south of Route 122A are vacant lots adjacent to an active rail line. There is vehicular access to the 1.15-acre southwestern lot, but the 1.27-acre lot to the north of Route 122A is locked behind the barbed wire fence. The southwestern lot has been pre-approved for residential development.	The northwestern lot has not been confirmed for development. Because the property is for sale, there is potential for development on the north parcel.


Jeff Frisch

The entrance into the floodplain is an unmarked footpath that has been created informally through pedestrian use.


Jeff Frisch

The Mill Villages Park on a sunny Thursday afternoon. The park and people visiting are subject to full sun exposure. Although there are only two people using the park, this is high use compared to the northern parcel.


Hillary Collins

One of the three locked gates that prevent entry into the northern parcel.


Hillary Collins

People eager to view the pond and river have created two illegal entrances such as this one on the westernmost edge of the northern parcel along Route 122A.

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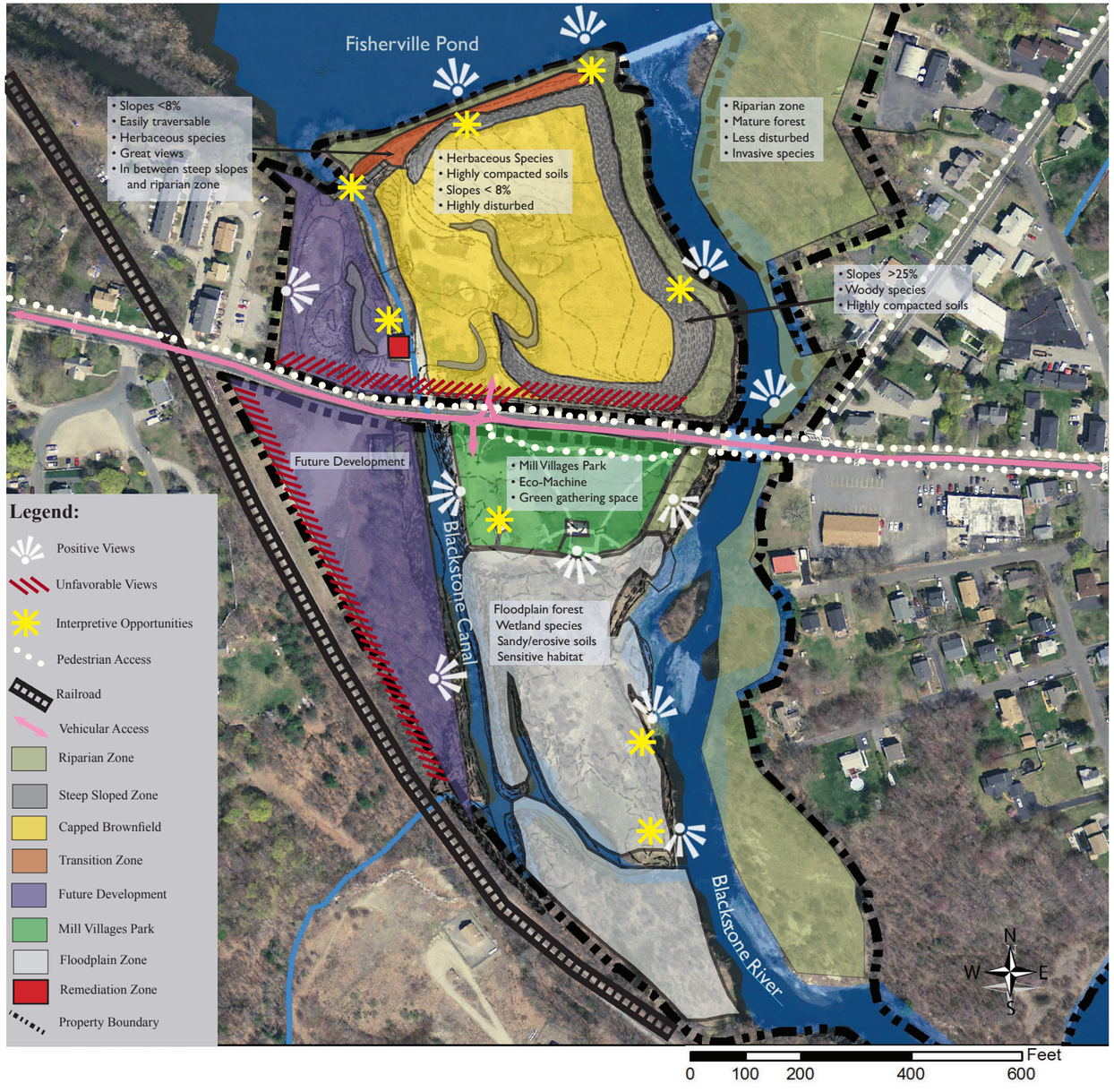
Access and Circulation A Landscape Master Plan for Fisherville Mill
Grafton, MA 01560

Hillary Collins,
Jillian Ferguson, and Jeff Frisch jr.

Spring 2015

Summary Analysis

The overlapping assets and constraints in topography, vegetation, access to natural resources, history, and relation to the surrounding area will influence the siting of trails, parking and interpretive stations. Keeping in mind that the site is currently for sale, buildings will likely be constructed on the property. Designing the landscape first could influence the placement of the future buildings. One of the site's largest asset is the contrast between the past industrial uses and the natural resources.



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	Observations	Implications
Riparian Zone	The forest is mature, with tall trees and a dense understory. The slopes on the west bank are 8-15 %. On the east bank, there is no slope data, but based on observation, slopes are flatter than on the west bank. Access to the west bank is restricted due to the barbed wire fence. The east bank is only accessible through a neighbor's property.	The ecology and ecosystems within a riparian zone can provide educational opportunities along a trail. The steeper slopes may require grading in order to create a universally accessible path. Thinning of the dense understory of native and invasive species will improve access and views.
Steep Slopes	The steep slopes were created when fourteen feet of fill were added to cap contaminants in 2004. The slopes exceed 25% grade. The area is highly disturbed due to prior contamination and the remediation processes. The soils are severely compacted; invasive species like *Ailanthus altissima* (tree of heaven) have begun to grow here.	The steep slopes limit accessibility and siting of trails. Although the invasive species are helping to stabilize the slopes, if they are not managed they will likely spread and replace native species. All steep slopes over 25% should be protected and vegetated.
Capped Brownfield	The nine-acre capped brownfield has slopes under 8% and sparse vegetation throughout. The top of the northern parcel is relatively flat with beautiful views to the east, west, north and south. It has highly compacted soils and invasive species have become established. Access to the top of the capped brownfield is limited due to the steep slopes surrounding it.	The flat area at the top of the northern parcel will require minimal grading for siting trails. Annual mowing and overseeding with a native meadow mix could help increase diversity and reduce woody invasives as well as create habitat.
Transition Zone	Between the riparian zone along Fisherville Pond and the steep slopes is a less disturbed area of 0.2 acres with slopes under 8%. It is a more accessible zone than the steep slopes on the brownfield and in the riparian zone.	The flatter slopes and less dense vegetation make this zone more accessible for siting trails. This transition zone can provide views of the pond and opportunities for education on the history of the Fisherville Pond and its part in the Atlantic Flyway.
Mill Villages Park	This two-acre park has slopes under 2% and is home to the Living Systems Laboratory (LSL). The client, Gene Bernat, owns the park, but it is open to the public. The LSL is within this zone and frequently visited. This area is highly modified by humans.	The LSL is a valuable educational resource for an interpretive trail system to teach about the current innovative remediation strategies taking place on the Blackstone Canal.
Floodplain	The floodplain has slopes under 5% and very sandy, erodible soils. The wildlife and its habitat in this area are sensitive to disturbance. There are unofficial trails through the floodplain. This is the richest ecological area on the property	Although the area is sensitive, formal trails placed appropriately could raise awareness of the necessity to protect the ecosystem and would also prevent high disturbance.
Future Development	The total area reserved for future development in this plan is 2.45 acres. The parcel on the northwest holds the granite that once formed the foundation of the mill. The southwest parcel is currently vacant and reserved for future development. The southwest parcel has unfavorable views of the railroad, which is very loud.	With more residents in the area and with planned access to the site, there are likely to be more users and more eyes on the site. There is potential to design the parcel north of Route 122A to be compatible with the interpretive trail system.
Remediation Zone	An oil skimmer in the canal currently remediates pollution from oil found in the soil and groundwater that continues to leak into the canal.	This zone will be fenced off for safety reasons, but can have informational panels on the outside of the zone to teach about the remediation taking place.

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Summary Analysis

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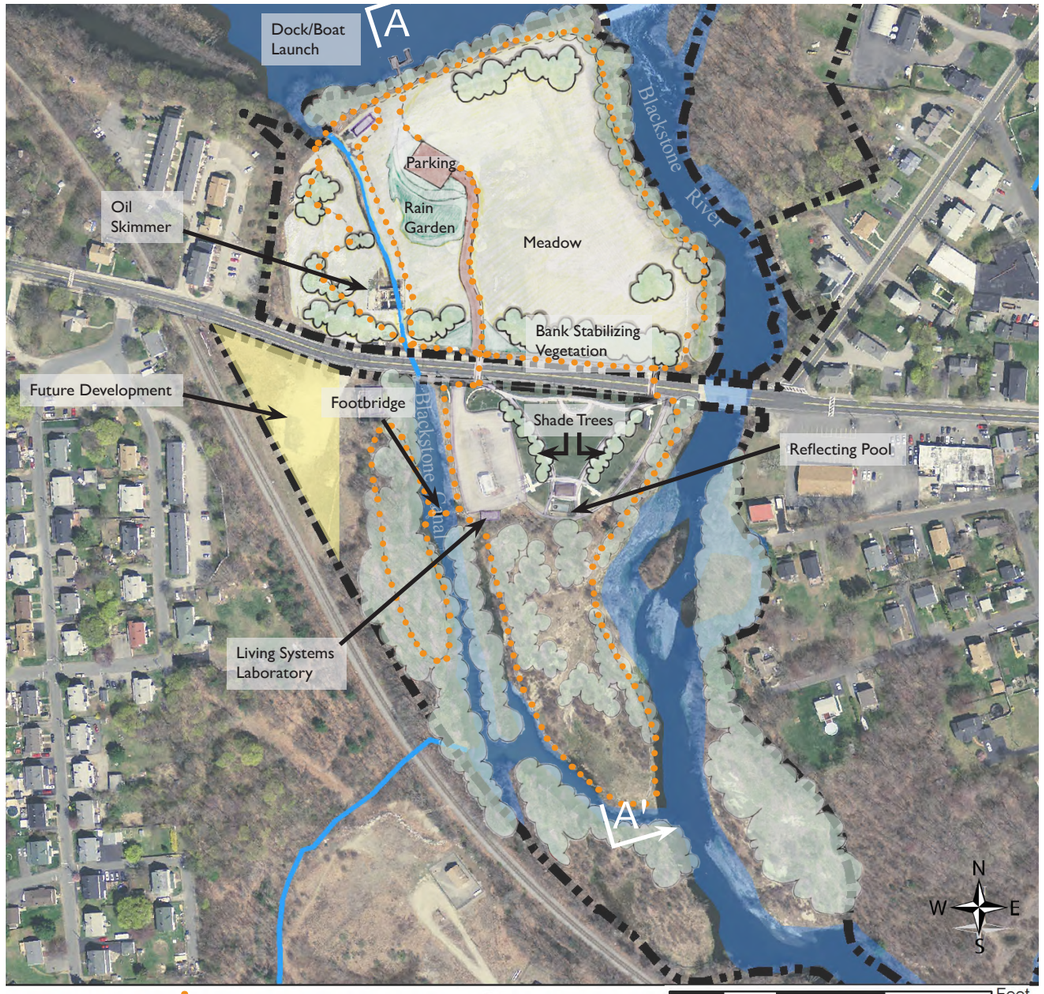
Alternative 1: Nature Prevails

***Nature Prevails* is a relatively low impact design. The southwestern parcel has been preapproved for development so it is left as is. The interpretive trail system emphasizes the ecology on the landscape, from the sandy floodplain in the south parcel, to the waterfall on the north parcel. The trail takes visitors through the wetland vegetation in the floodplain with destination points that give the visitor the chance to stop and observe the different wildlife and vegetation species in the area. The river walk in the north parcel along the Blackstone River contrasts with the floodplain walk in the south parcel. The visitor walks under thinned trees to more viewing destinations to learn about the site's history and the natural processes that have taken over since the mill was removed.**



North Parcel

Pros

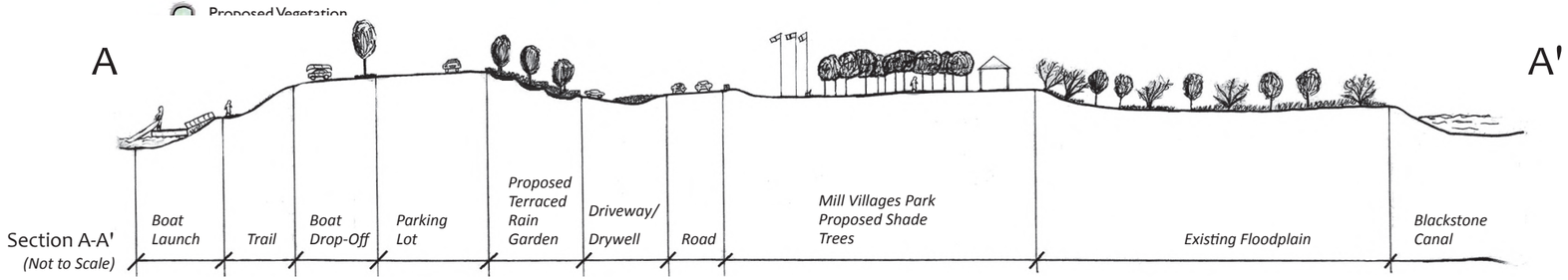
- Native vegetation stabilizes the steep slopes and inhibits invasive species.
- Meadow grass provides habitat for ground nesting birds.
- Up to eighteen cars can park in a new parking lot.
- A terraced rain garden adjacent to the parking lot provides an attractive stormwater management feature.
- A 3,165-foot-long interpretive trail around the periphery of the property allows visitors to learn about the area and to take in beautiful views of the step dam, Blackstone River, and Fisherville Pond.
- Visitors can launch small boats, canoes, or kayaks from a dock or launch at Fisherville Pond.
- A 100-foot trail with an 8% grade from the parking lot allows boat users to bring their boats to the water.
- Most of the northern parcel is left available for future construction of buildings.

Cons

- Visitors must carry their boats 100 feet from the parking area to the boat launch down an 8% slope.
- Bank stabilizing vegetation is only planted along the southern slope facing the street. Meadow grasses planted on the eastern slope may not prevent erosion and would be harder to mow than the flat plateau of the capped brownfield.
- The meadow mix and tall grasses will be challenging to mow annually on the steep eastern slope.

South Parcel

- Trees planted in the Mill Villages Park provide shade for visitors.
- A frog pond behind the current pavilion is an attractive water feature.
- The Living Systems Laboratory is expanded closer to the bank of the canal, to increase filtration capacity.
- A 1,995-foot-long trail is constructed in the southern parcel.
- A bridge over the canal connects to the southwestern parcel where a circular trail goes through the woods to explore the historic railroad and the canal.
- The interpretive stations in the floodplain educate visitors on the wildlife, vegetation and ecological functions.
- The trail in the floodplain is not a raised boardwalk, which could lead to more degradation and negative impact on the fragile habitat in an area that is already eroding.
- There is no additional vegetation in the southern parcel to stabilize the river bank.



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A Landscape Master Plan for Fisherville Mill

GRAFTON, MA 01560

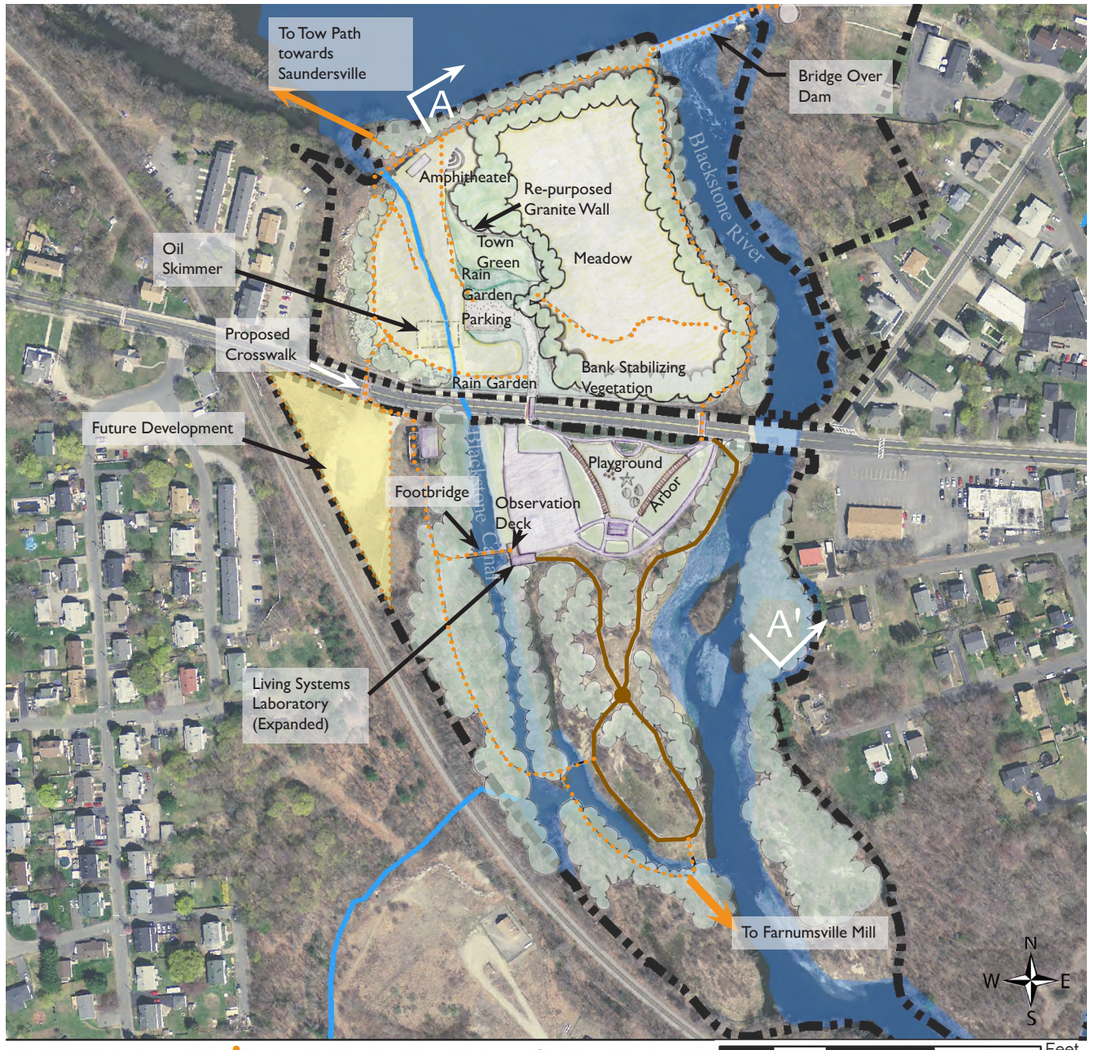
Nature Prevails

HILLARY COLLINS, JILLIAN FERGUSON, AND JEFF FRISCH JR.

SPRING 2015

Alternative 2: Community Connections

This design emphasizes the connection to the town and beyond, connecting on-site trails with the old tow path and extending south to the Farnumsville Mill. The western parcel, south of Route 122A, is reserved for future development. A natural playground in the Mill Villages Park provides a space for smaller children and families from the residential neighborhoods in the area. This design integrates the northern and southern parcels and provides a space for people of all ages to gather and recreate.



North Parcel

Pros

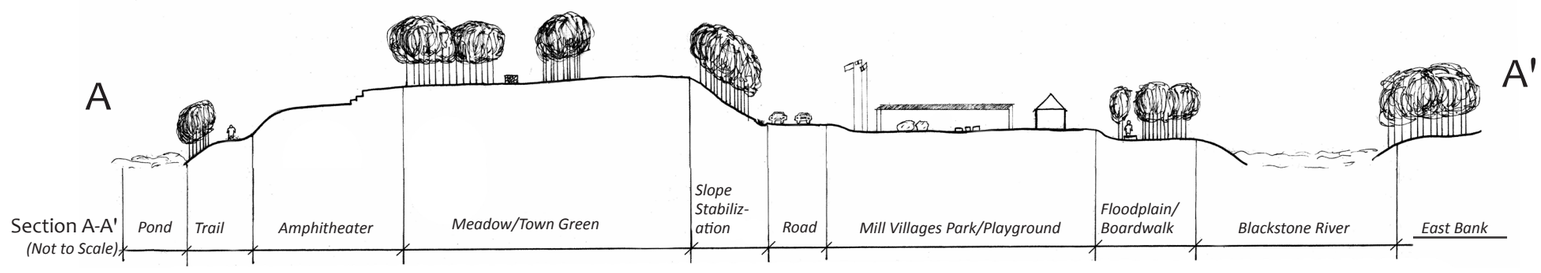
- Vegetation stabilizes the slopes and shades the perimeter trail.
- A new parking lot hold 22 cars.
- The sidewalk along the driveway provides pedestrians access to the trail.
- A 2/3-acre green offers space for community gathering.
- An attractive rain garden infiltrates stormwater from the parking lot and abuts the town green.
- The granite from the old foundation is repurposed to make a stone wall along the town green to separate the meadow and the lawn.
- The 2,930-foot-long trail meanders along the pond and river banks, with interpretive signs about industrial and environmental history and natural processes.
- A meadow provides habitat for birds, such as killdeer.
- An amphitheater built into an existing slope creates an outdoor classroom and gathering space for 30 people.
- A bridge over the dam to an observation platform connects the northern parcel to the opposite side of the river for another view of the waterfall.

Cons

- A bridge directly over the dam reduces the attractive view from other points on the trail.
- There is no boat launch in this design.
- Earth moving and grading are required to create the amphitheater.

South Parcel

- A playground with logs, boulders and sand pit creates a space for young children to play.
- Vegetated pergolas shade the existing pathways in the Mill Villages Park.
- The Living Systems Laboratory is moved and expanded to allow for plant propagation.
- A 3,110-foot-long trail system is constructed in the southern parcel.
- A 1,610-foot-long boardwalk in the floodplain minimizes further impact on the habitat and keeps people from straying off the path. It is inset from the bank by thirty feet.
- A crosswalk between the southern and the northern parcels creates safer crossing.
- Bridges connect the trails across the Blackstone Canal
- The boardwalk meanders through sensitive areas, potentially reducing habitat and requiring the construction of additional flood storage for square footage displaced by boardwalk footings.
- A boardwalk to Farnumsville is costly and requires maintenance.
- Implementation of bridges requires extensive engineering and has higher costs.
- Natural playground displaces lawn space.



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A Landscape Master Plan for Fisherville Mill

Grafton, MA 01560

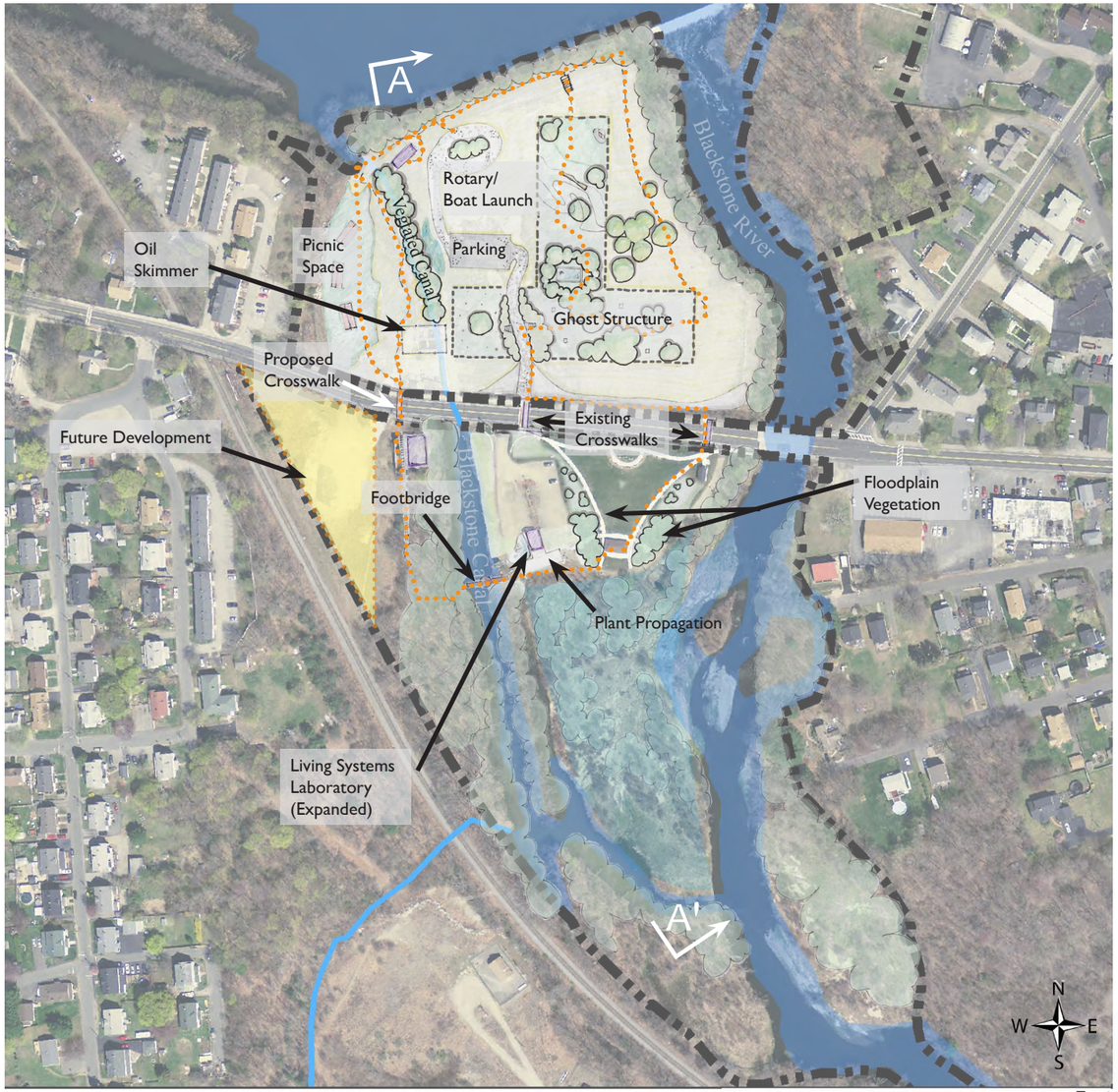
Community Connections

Hillary Collins,
Jillian Ferguson, and Jeff Frisch Jr.

Spring 2015

Alternative 3: Industry: Past, Present & Future

***Industry: Past, Present & Future* highlights the industrial history of the site. A "ghost footprint" of the old mill building uses granite from the original foundation, creating a ruin-type interpretive park on the northern parcel. Visitors travel through the structure and perceive the size of the old building. Interpretive trails are limited to the northern parcel with a few main destination points that educate visitors about the old industrial history of the site. The Living System Laboratory is an example of the present and future direction industry is taking, using biological processes to remediate the oil contamination to protect the habitat. No trails are sited in the floodplain.**



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Pros

North Parcel

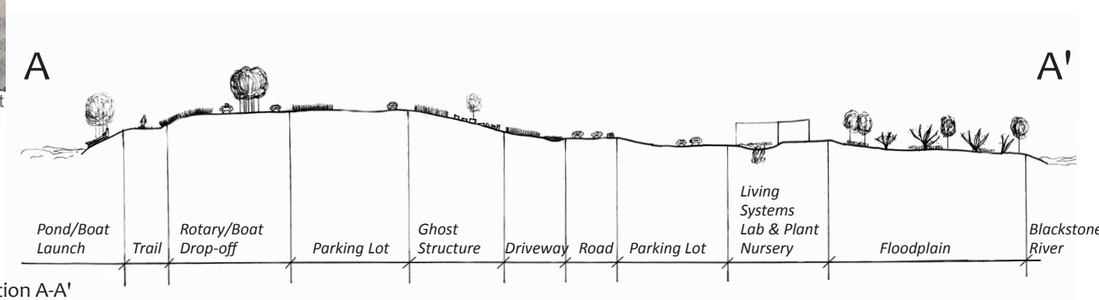
- The old granite is repurposed for the ghost footprint, which serves as a park area for passive recreation. The structure serves as a seat wall with scattered trees to provide shade.
- Visitors can launch small boats, canoes, or kayaks from a dock or launch at Fisherville Pond.
- A 3,165-foot-long trail travels around the northern parcel.
- Native vegetation provides shade and stabilizes slopes.
- Meadow grasses create an inviting space for visitors.
- A twenty-two-stall parking lot allows visitors direct access to the trail and boat drop-off.
- A picnic space provides an area for people to gather and have a bite to eat.

South Parcel

- The Living Systems Laboratory is moved to allow for more parking space in the existing lot.
- The Living Systems Laboratory is expanded to provide a classroom and space for indoor plant propagation.
- Floodplain species are planted in the Mill Villages Park to provide shade and to educate visitors about the natural context.
- An observation deck is added to the Living Systems Laboratory.
- A bridge from the observation deck over the canal brings visitors across the canal.
- The floodplain has unofficial trails limit foot traffic.
- The interpretive trail meanders on the southwestern parcel along the abandoned railroad tracks, giving visitors the chance to learn about the history of the railroad.
- A crosswalk between the southern and northern parcels creates convenient crossing.

Cons

- The trails do not travel along the banks of the river, missing opportunities for education on the riparian ecosystems.
- The location of the ghost footprint is vulnerable to future development, a labor-intensive but temporary installation.
- With no marked trails in the floodplain, there is potential for more harmful impact from foot traffic.
- The Mill Villages Park remains exposed to full sun.
- The trail in the floodplain is not a raised boardwalk, which could lead to more degradation and negative impact on the fragile habitat in an area that is already eroding.
- There is no additional vegetation in the southern parcel to stabilize the river bank.



Section A-A'
(Not to scale)

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Industry: Past, Present & Future

A Landscape Master Plan for Fisherville Mill

Grafton, MA 01560

Hillary Collins,
Jillian Ferguson, and Jeff Frisch Jr.

Spring 2015

18/30

Final Design: Overview

The final design for the Fisherville Mill site creates an educational, historical, and ecologically vibrant landscape for the residents of Grafton.

1. Interpretive materials and exhibits appear throughout the site.

The trails in the final design highlight unique features and destinations of interest such as the floodplain, the dam, and the Living Systems Laboratory. Interpretive panels educate visitors on the different historical and natural features on the site.

2. Trails and other connections link the site.

The trails in the final design connect south towards Farnumsville and north along the Blackstone Canal's historic tow path towards Saundersville; which are both within a quarter-of-a-mile from the site.

3. The Living Systems Laboratory is expanded and relocated.

The Living Systems Laboratory is expanded and moved closer to the Blackstone Canal. An observation deck with a footbridge is added as well as a space inside the structure for plant propagation.

4. Land is set aside for future mixed-use development.

The northwestern and southwestern parcels are reserved for future development, per the owner's request. The northwestern parcel becomes a meadow, which may be lost to future construction. No new vegetation or trails are placed on the southwestern parcel since it has been preapproved for residential development. A trail from the footbridge could connect to the development but is not included in this design.

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A Landscape Master Plan for Fisherville Mill

GRAFTON, MA 01560

FINAL DESIGN: OVERVIEW

HILLARY COLLINS, JILLIAN FERGUSON, AND JEFF FRISCH JR.

SPRING 2015

Final Design: North Parcel

North Parcel

1 Visitors drive and park or walk up the main gravel driveway or sidewalk. If they have a boat, a cul-de-sac farther up the drive offers a boat drop-off zone and a ninety-foot trail to a boat launch.

2 From the parking lot, pedestrians enter a green space and walk along a trail parallel to the canal that meets the boat trail. The trail also connects to the old tow path and on to another trail that leads off-site.

3 A rain garden filters and infiltrates polluted stormwater that flows off the cul-de-sac.

4 The boat path takes the visitor east along the bank of Fisherville Pond. Interpretive panels located along the path inform visitors about the migratory bird flyway and the wildlife in the area.

5 An amphitheater with views of the pond can be used as an outdoor classroom to teach bigger groups.

6 An observation platform looks over the waterfall. Visitors can stop, sit and read interpretive panels about the waterfall and its relationship to the Fisherville Mill.

7 Just south of the observation platform, a pedestrian bridge leads visitors to the east bank to another gathering and viewing space.

8 Traveling south along the Blackstone River, the universally accessible River Walk is shaded by mature cottonwoods and red maples. The slope to the west is covered with low shrubs, stabilizing the erodible soils.

9 A spur from the trail leads the visitor to a small alcove. The walls are remnants of the foundation of the old mill, built into the slope. A small seating area allows visitors to stop and learn about the mill building and related history. From the alcove, thinned trees and understory allow visitors another view of the waterfall.

10 From the River Walk, visitors have a choice of hiking up a flight of stairs or continuing to the road.

11 Up the stairs, the visitor is brought to the top of the slope where granite blocks are laid out in the footprint of the old mill, creating an interpretive "ghost footprint." Meadow grasses shape the trails that span the space, one traveling along the frame of the structure, and another serpentine trail through the middle. Various benches and old parts of mill machinery are scattered around the area, inviting interaction and interpretation. Stairs on the west side of the ghost structure lead the visitor back to the main entrance along the driveway.

12 A universally accessible path is available further north, to the west, bringing the visitor to the sidewalk along the cul-de-sac and finally back to the parking lot along the Blackstone Canal.

13 The path in the ghost structure ultimately connects with the River Walk adjacent to the amphitheater, creating a loop trail and giving numerous chances for the visitor to learn about the Blackstone River, the Blackstone Canal, the Fisherville Pond, and how they shaped the industrial history of the mill.

*Not for construction. This drawing is part of a student project and is not based on a legal survey

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Final Design: North Parcel A Landscape Master Plan for Fisherville Mill

Grafton, MA 01560

Hillary Collins,
Jillian Ferguson, and Jeff Frisch Jr.

Spring 2015

Final Design: South Parcel

South Parcel

1 Visitors traveling by vehicle enter the south parcel through the only gravel driveway. The two aisles of the parking lot are separated by a rain garden, for added vegetation and stormwater management.

2 Pedestrians walk along the south side of Route 122A and enter the park either from the west or east, under vegetated arbors on either side of the park. Visitors can sit and relax on benches under the shade.

3 Along the canal, the Living Systems Laboratory filters 10,000 gallons a day and has a classroom space for bigger groups to learn the details of the remediation process. One area within the Living System Laboratory is designated for plant propagation. An observation platform attached to the outside of the LSL looks out over the canal.

4 Visitors are drawn to the constructed wetland garden where they walk along a boardwalk and learn about the various species and functions of a wetland. The client is also interested in using this garden as a potential propagation space.

5 The wetland garden intersects with another raised boardwalk, leading visitors into the sandy floodplain. The raised boardwalk is inset from the bank 15 to 20 feet to reduce erosion of the bank. Certain destination points bring visitors out to the bank to view the Blackstone River and learn the dynamic nature of rivers and floodplains. A center destination point in the middle of the floodplain gives visitors the chance to see and learn about different vegetation and the changing landscape in the floodplain.

6 At the southern tip of the floodplain, visitors encounter the convergence of the Blackstone Canal and the Blackstone River at a small spillway. Here visitors are educated on the wildlife in the floodplain and how and why the floodplain is a suitable habitat for many species. A bridge leads visitors across the spillway to walk along the bank of the facing floodplain.

7 Continuing north along the boardwalk, visitors can choose between going east, back into the floodplain, or turning to the west side of the Blackstone Canal.

8 This segment of the trail highlights the abandoned railroad that once transported the goods produced in the Fisherville Mill to Worcester or Providence for trade.

9 The trail meanders through the woods until it intersects with the canal, where a footbridge brings the visitor back to the observation deck off the Living Systems Laboratory. This connection will require grading or stairs.

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Landscape Master Plan for Fisherville Mill
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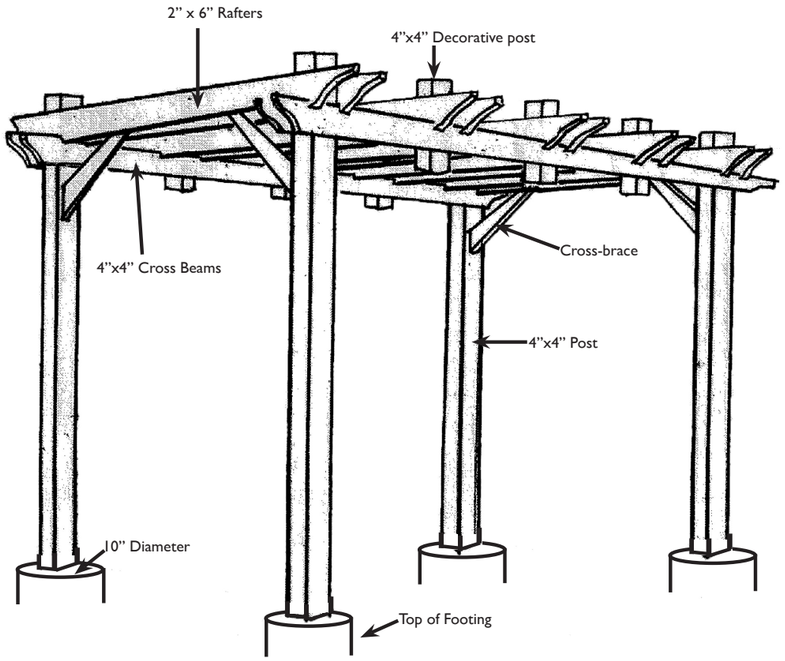
Final Design: South Parcel A Landscape Master Plan for Fisherville Mill

Hillary Collins,
Jillian Ferguson, and Jeff Frisch jr.

Spring 2015

Design Details: Arbor

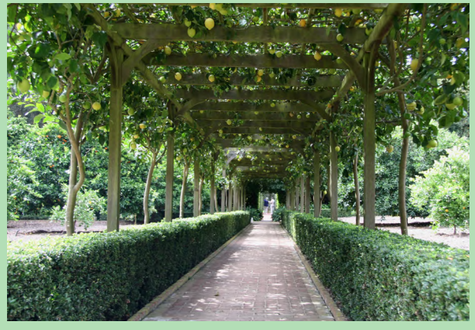
A vegetated arbor provides shade along the pathways in Mill Villages Park, and adds an engaging vertical element to the now bare park in mostly full sun. The arbor is constructed with rot-proof wood and stainless steel fasteners, and set on concrete pier footings.



Typical Arbor Detail
The ten-foot-wide arbors will be covered with non-invasive vines, which will provide shade for the visitors in the Mill Villages Park.

Vegetated Arbor

A vegetated arbor in California is the inspiration for the arbor that is proposed for the Mill Villages Park, which currently is mostly exposed to the sun. Vining varieties such as native honeysuckle will grow along the arbor, providing shade for the benches beneath.



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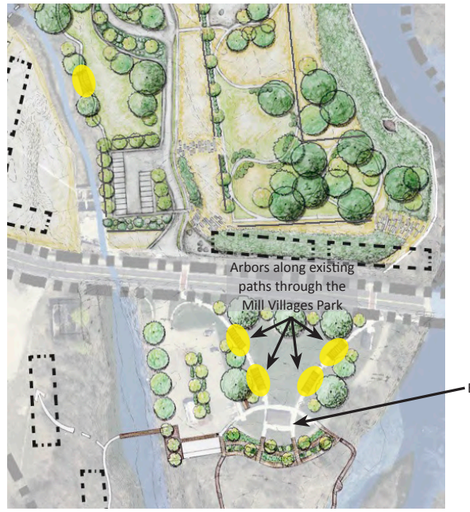

(Key Plan not to scale)

The Mill Villages Park green is fully exposed to the sun. Arbors lining the pathways can help to encourage pedestrians to visit the park, while protecting them from full sun.

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A Landscape Master Plan for Fisherville Mill
Grafton, MA 01560

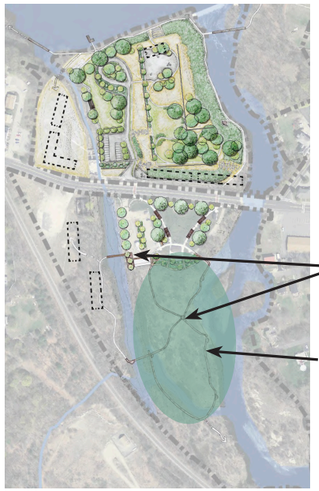
Design Details: Arbor

Hillary Collins,
Jillian Ferguson, and Jeff Frisch Jr.

Spring 2015

Design Details: Boardwalk & Observation Platform

A universally accessible boardwalk through the floodplain results in less compaction and erosion of the sandy soils than on-ground trails. Observation platforms along the boardwalk create destinations for visitors to stop and enjoy views. Interpretive signs and panels encourage visitors to engage with the Blackstone Canal and the floodplain.



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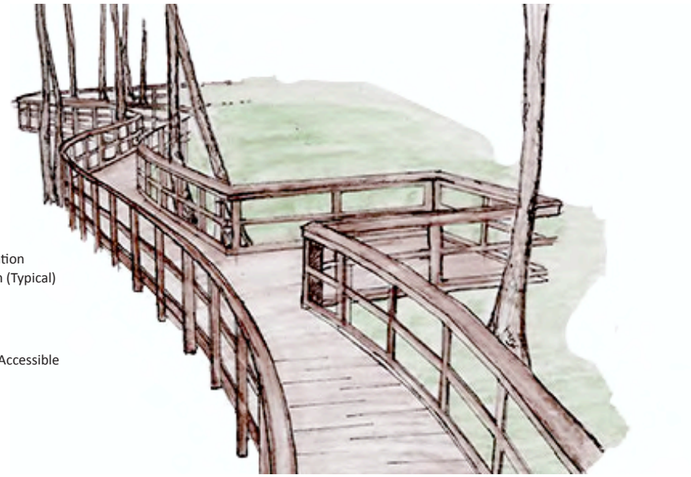
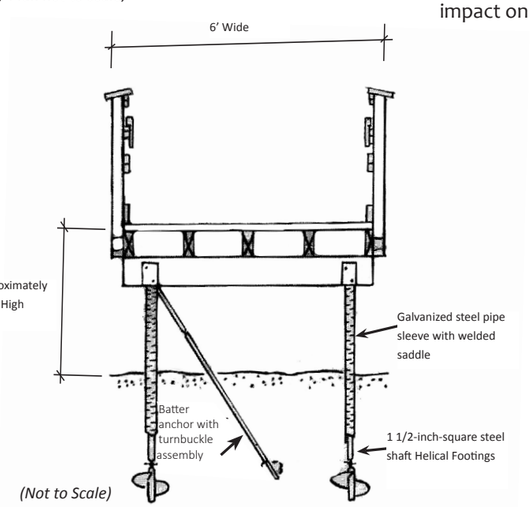


The boardwalk through the floodplain has minimal impact on the sensitive soils.

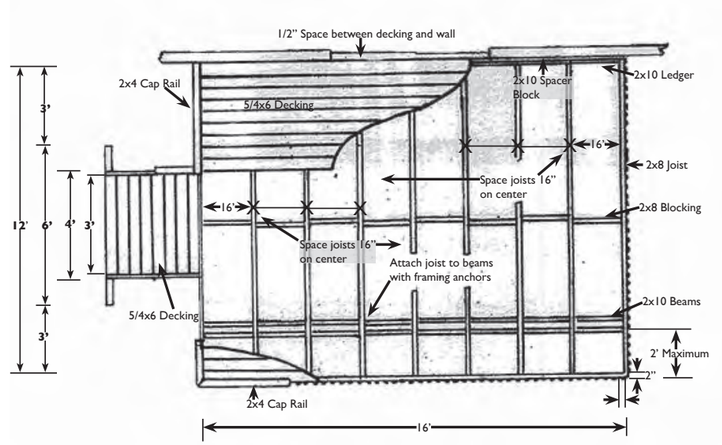
In certain areas of the floodplain, the vegetation is low and shrubby. The trees generally do not exceed twenty-five feet, allowing visitors on a boardwalk an extensive view of the floodplain landscape.



(Not to Scale)

Helical Footings or Diamond Piers
Helical anchors and diamond piers have the smallest footprint of all boardwalk footings. Low impact footings will require very little cut or fill in the wetlands, minimizing erosion and requiring very little wetland replication area.

Platform Plan Detail
All wood platforms will be constructed with rot-proof wood and attached with stainless steel fasteners. It is important to avoid pressure treated wood so chemicals are not leached into the river in storm events.



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Arcadia Wildlife Sanctuary

The interpretive boardwalk at the Arcadia Wildlife Sanctuary in Easthampton, Massachusetts, is accessible to all people. The boardwalks and trails on the Fisherville Mill site could incorporate interpretive signs along the boardwalk at certain destinations that have educational, biological or historical significance.

Beth Batchelder

O'Leno State Park, Santa Fe

This observation deck is an inspiration for the platform destinations proposed on the northern and southern parcels. An observation platform on the Fisherville Mill site would provide visitors with a resting and viewing point.

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A Landscape Master Plan for Fisherville Mill
GRAFTON, MA 01560

Design Details: Boardwalk & Observation Platform

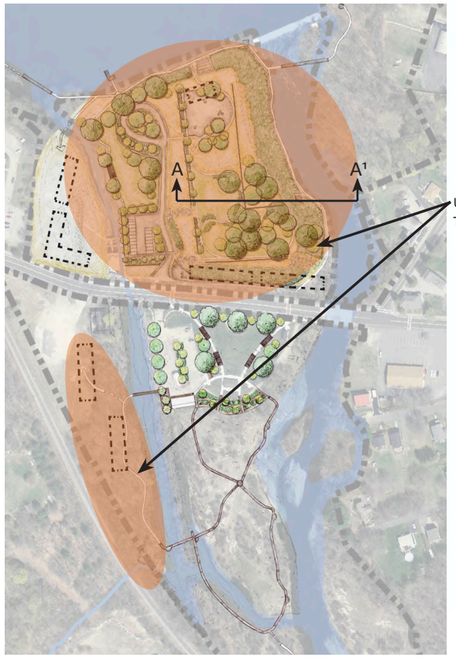
Hillary Collins,
Jillian Ferguson, and Jeff Frisch jr.

Spring 2015

Design Details: Trails

Reusing granite from the old foundation, a footprint of the mill is laid out to mimic the ruins of the building. Trails meandering through give a visitor the chance to experience the mass of the former mill building. Classic mill machinery is placed along the path with signs, illustrating how the mill operated in the past.

The universally accessible river walk along the Blackstone River is separated from the ghost structure by steep vegetated slopes. Various destinations along the walk provide views of the waterfall and interpretive materials about the industrial history of the river, river and pond ecology, and the connections between them.



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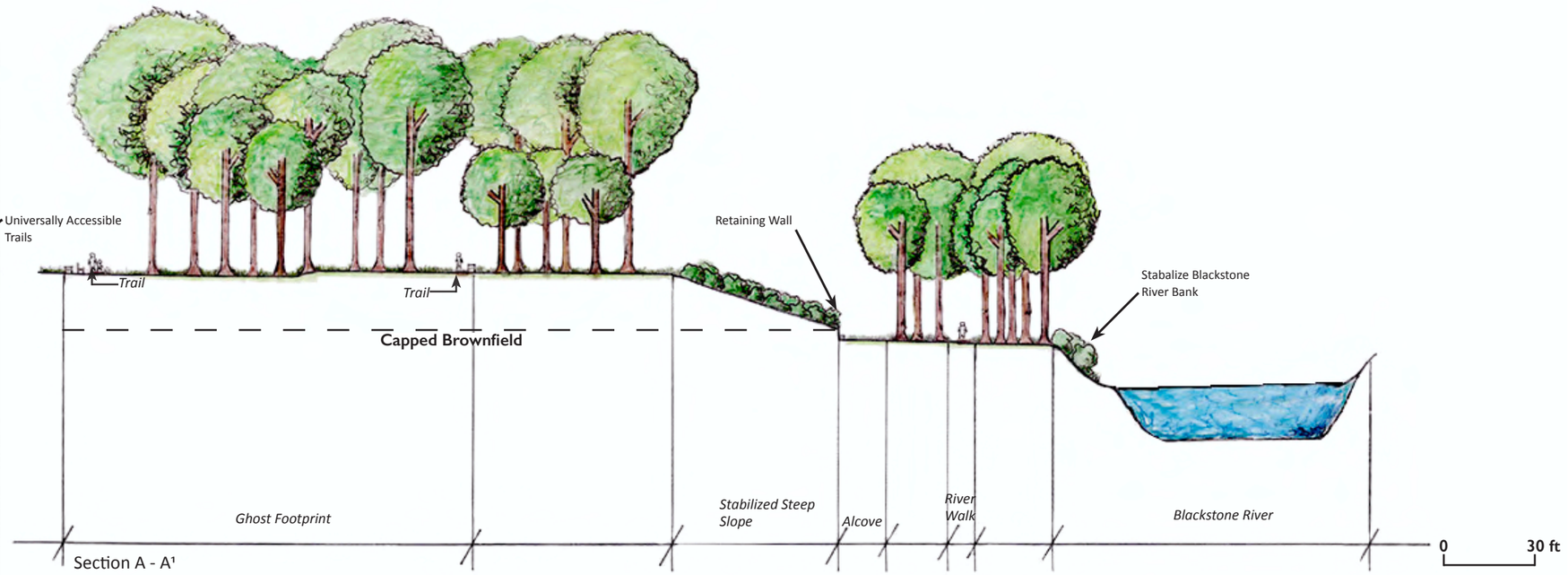
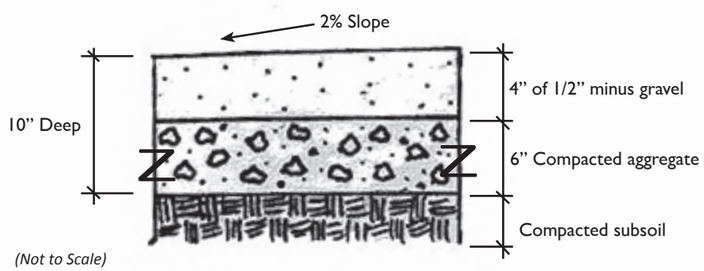


Section A - A¹

The southern end of the "ghost structure" includes a dense canopy of trees, providing shade for walkers and those seated on benches throughout. Low/ no-mow lawn grows within the structure's low walls. Steep banks are thickly planted, providing stabilization. Beneath this vegetated slope, a quiet seating area, constructed with remnants of the mill's structure, maintains pleasant views of the Blackstone River.



(Not to Scale)

Typical Detail of Gravel Paths
The ADA trails are six feet wide throughout the Fisherville Mill property. The ADA trails are graded to a 5% or less longitudinal slope to ensure universal access with a 2% cross slope to drain water.

Jewry Museum Ruins

These old stone wall ruins are found at the Jewry Museum in Leicester, England. These are among the largest Roman civil architecture to survive today in Britain. The "ghost structure" in the final design was inspired by these ruins and attempts to evoke a similar feel for the visitor, and to create a window into the past.

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Grafton, MA 01560

Design Details: Trails

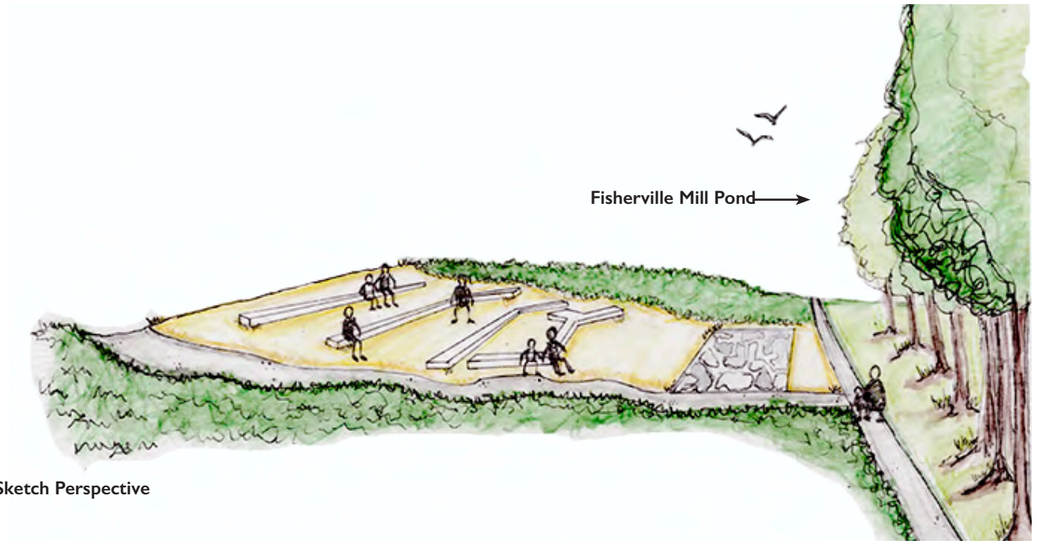
Hillary Collins,
Jillian Ferguson, and Jeff Frisch jr.

Spring 2015

Design Details: Stonework

The amphitheater is a destination along the trail. It provides visitors a seat to view the various species of birds that use/travel the flyway or a gathering place for a community class or performance. Interpretive and educational panels are posted for visitors to learn about the significance of the flyway and about the industrial use of the Fisherville Pond and Blackstone River. The amphitheater helps control erosion, while providing seating along the steep slope.

The ghost structure's granite blocks create a modern geometric formation, help manage erosion on steep slopes, and provide additional seating space and places for kids to walk along and jump from.



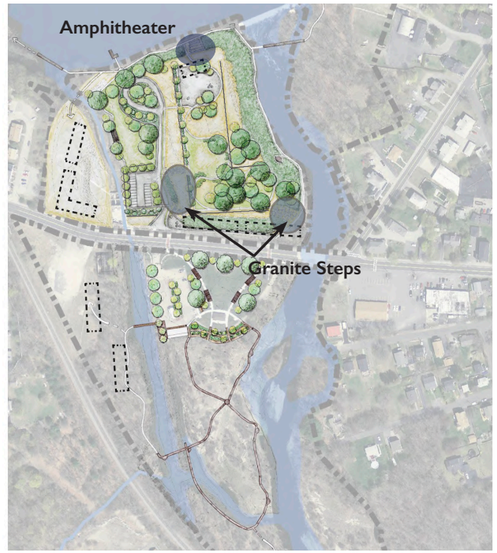
Sketch Perspective

The amphitheater is built into the side of the northern slope, looking north over Fisherville Pond. People can sit and enjoy a small performance and observe different species of birds over the flyway, and watch a beautiful sunset over the pond. The amphitheater also acts as an outdoor classroom for larger groups visiting the property.

Sidwell Friends School

This terraced garden at the Sidwell Friends School in Washington, D.C. is an inspiration for the amphitheater garden proposed for the steep slopes on the Fisherville Mill site. It is an attractive destination for people to sit, it is a small venue for a classroom or event, and it controls erosion. The structure is built into the slope, using the granite blocks as seating.

canticleforleibowitz.blogspot.com



(Key Plan not to scale)

Repurposed granite blocks from the old foundation become naturalized steps for pedestrians to traverse steep slopes between the River Walk and the ghost structure on the plateau.

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Landscape Master Plan for Fisherville Mill

GRAFTON, MA 01560

DESIGN DETAILS: STONEWORK

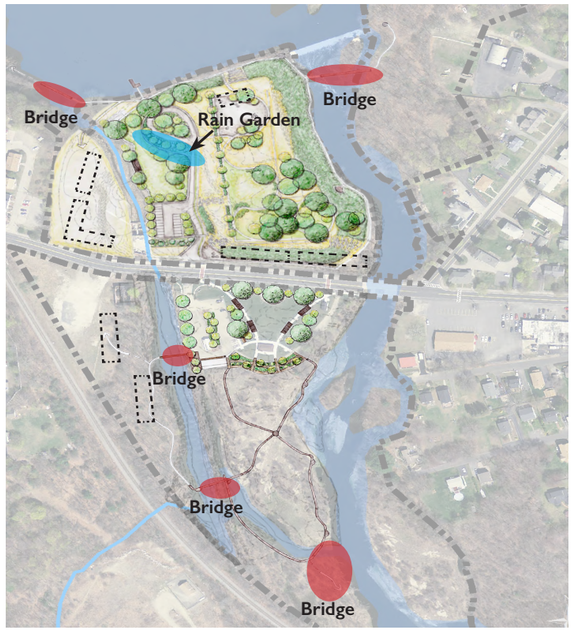
HILLARY COLLINS,
JILLIAN FERGUSON, AND JEFF FRISCH JR.

SPRING 2015

Rain Garden & Bridge Precedents

A rain garden south of the cul-de-sac on the northern parcel slows, cleans, and infiltrates stormwater runoff from the gravel lot. These attractive gardens help manage the volume of stormwater and reduce erosion.

Bridges are necessary to connect the trails across water bodies. Due to the large distances involved on the property, detailed engineering is required to design and site a bridge appropriately.



(Key Plan not to scale)

David Weber

Rain Garden 1
A recently constructed rain garden in Harford, Connecticut, manages stormwater ecologically, replenishing ground water, and treating and infiltrating polluted runoff keeping it out of water bodies. The rocks on the steeper slopes slow water flow into the garden and keep the steep slopes from eroding. Gardens such as this one are proposed south of the cul-de-sac. Plants are chosen based on their ability to withstand fluctuating times of drought and flooding.

David Weber

Rain Garden 2
Another perspective of the Hartford rain garden shows the size and depth of one portion of the garden. The garden south of the cul-de-sac could include large stones for people to cross over.

Bridge 1
This steel truss footbridge spans a water body. No piers enter the water, as is also desired for the Fisherville Mill site.

Bridge 2
A wooden footbridge may be more appropriate for shorter distances and more naturalized sites. The footbridge has only one foundation on each side of the water body, avoiding impact in the water body itself.

Bridge 3
This bridge is constructed with I-beams and is universally accessible. The footing on either side of the bank is larger than the previous examples, but is sturdy and durable. Gabion baskets cretae inexpensive retaining walls, and can eventually be screened with plants or left exposed.

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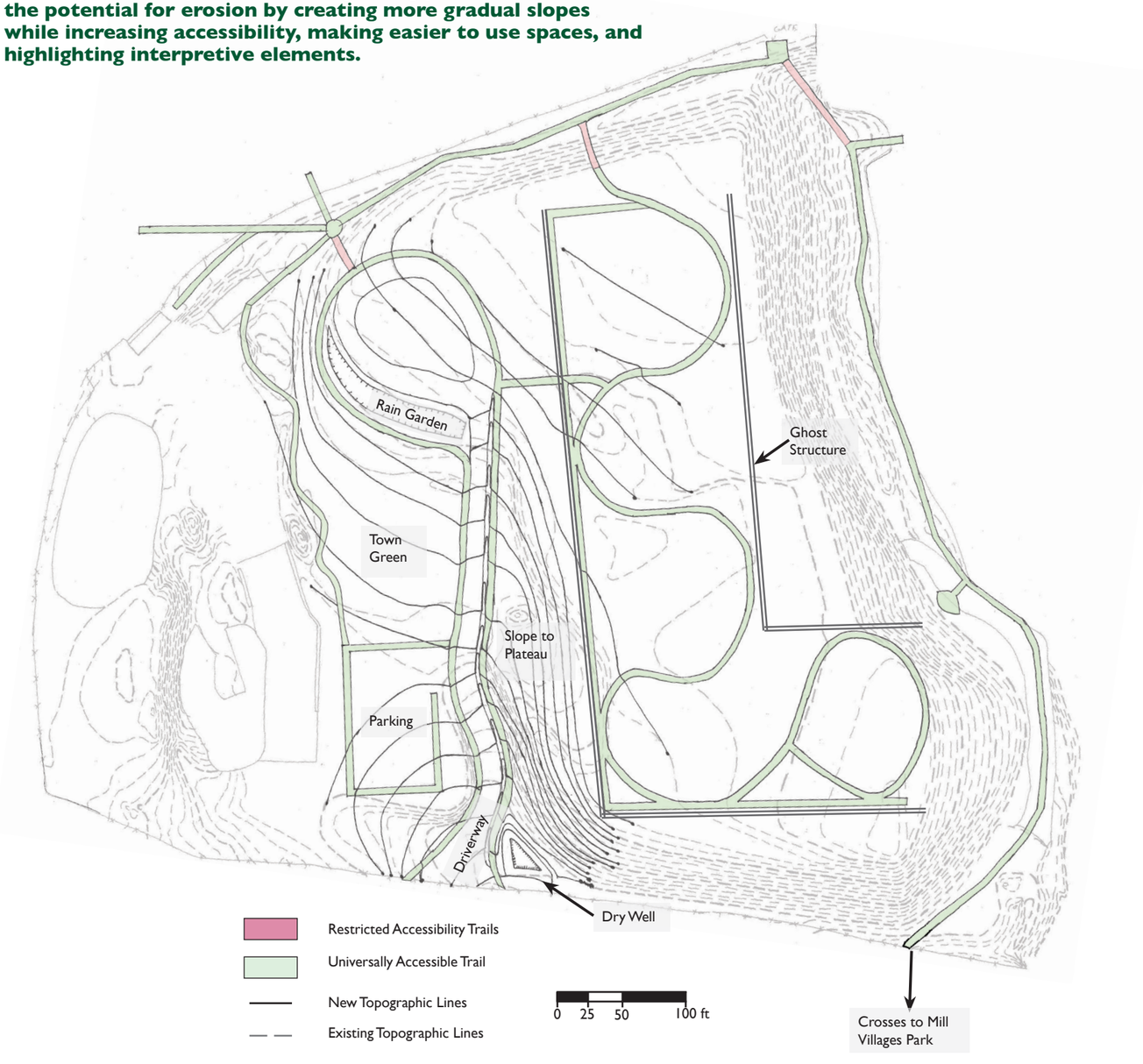
A Landscape Master Plan for Fisherville Mill
Grafton, MA 01560

Rain Garden & Bridge Precedents

Hillary Collins,
Jillian Ferguson, and Jeff Frisch jr.
Spring 2015

Grading Plan: North Parcel

The steep slopes on the north parcel make it difficult for two-way vehicle traffic and universally accessible paths from the road to the top of the plateau and Fisherville Pond. The steep slopes have created an erosion channel and many areas with high erosive potential. This grading plan seeks to lower the potential for erosion by creating more gradual slopes while increasing accessibility, making easier to use spaces, and highlighting interpretive elements.



Rain Garden

The upslope cul-de-sac has been graded to convey water to the rain garden and limit the water that will run down and erode the driveway. The slopes on the path around the cul-de-sac are less than 5%, making it a universally accessible trail, though a spur off this path has steps due to the steep slopes and will have restricted accessibility. The rain garden has been excavated to provide a place to hold water and let it percolate into the soil.

Town Green

Steep slopes that exceed 8% have been made shallower by creating a more constant slope from the rain garden to the parking lot. Much of this area is under 5%, making it easy to traverse and enjoy. It also has a south-facing slope that will be warm and sunny on cool days.

Slope to Plateau

Extremely steep slopes and undulating topography have been made shallower and more uniform. This reduces the erosive potential and eliminates the erosive channel. The new slope parallels and accentuates the ghost structure.

Parking

The parking lot slope has been graded to help make the lower section of the driveway more accessible and reduce potential for pooling. The slope is now between 2% and 5%, increasing its ability to shed water. The slopes are rounded and of a constant slope to reduce the possibility of the water being channelized.

Driveway

The slope of the driveway is graded to less than 5% so the adjacent sidewalks are universally accessible from the road to the top of the plateau. Between the road and the sidewalk, a vegetated swale collects and conveys water to the decorative and functional drywell at the bottom of the slope. The vegetation helps to slow stormwater and minimize sedimentation of the drywell by reducing erosion.

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Grading Plan

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Spring 2015

Planting Plan

A large meadow and lawn provide an open landscape, shrubs stabilize steep banks, and trees provide shade along trails. The increased biodiversity provides shelter, habitat and forage for wildlife, including migratory birds, while presenting a delightful sensory experience for people walking through the Fisherville Mill site.

Meadow Establishment (Typical)

Once established, a meadow can require less annual maintenance than a lawn, reduce stormwater runoff, and promote biodiversity. A diverse meadow can take a few years to create with a more intense maintenance regime in the beginning to deplete the existing seed bank and allow for the desired plants to take root. Due to the site's history of contamination, methods to establish the meadow should not disturb the ground surface where the remediation and stabilization has taken place.

To Establish Lawn/Meadow

- October: mow lawn and meadow area late in the month
- Over seed in fall before the first freeze
- Rely on spring rains to initiate and irrigate seeds
- Over seed again in the spring while the ground is still frozen

Meadow Mix

Prairie Moon Nursery's Grand Diversity Mixed Height Prairie Seed Mix offers a hundred species, including a variety of flowers that bloom from early spring to fall, and can handle a range of soil conditions. The mix is particularly supportive of birds and butterflies.

Plant species in a mix from low to high to prevent desirable views of the mill waterfall and Fisherville Mill Pond from being blocked.

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Planting Plan

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Spring 2015

Planting Schedule & Details

Common Name	Scientific Name	Type	Soil/Wet or Dry	Height	Width
Small Trees					
Eastern Redbud	*Cercis canadensis*	Small Tree	Well Drained	20-30'	15-35'
Serviceberry	*Amelanchier laevis*	Small Tree	Tolerant	15'	15'
Crabapple	*Malus spp.*	Small Tree	Well Drained	6-10'	6-12'
Large Trees					
Red Maple	*Acer rubrum*	Large Tree	Drought Tolerant	20'	39'
Silver Maple	*Acer saccharinum*	Large Tree	Drought Tolerant	50-80'	35-50'
Yellow Birch	*Betula alleghaniensis*	Large Tree	Moist/Tolerant	60-75'	35-50'
River Birch	*Betula nigra*	Large Tree	Moist/Tolerant	40-70	40-60'
Sycamore	*Platanus occidentalis*	Large Tree	Moist/Tolerant	40-100'	40-70'
Weeping Willow	*Salix babylonica*	Large Tree	Moist/Tolerant	30'40'	35'
Small Shrub					
Rugusa Rose	*Rosa rugosa*	Small Shrub	Well Drained	4-8'	4-6'
Medium Shrubs					
Arrowwood Viburnum	*Viburnum dentatum*	Medium Shrub	Moist/Tolerant	6-10'	6-10'
Common Ninebark	*Physocarpus opulifolius*	Medium Shrub	Moist/Tolerant	8'	8'
Large Shrubs					
Red-osier Dogwood	*Cornus sericea*	Large Shrub	Moist/Tolerant	8-12'	6-9'
American Hazelnut	*Corylus americana*	Large Shrub	Well Drained	10-16'	8-13'
Common Witchhazel	*Hamamelis virginiana*	Large Shrub	Moist/Well Drained	15-20'	15-20'
Wetland Garden					
Big Bluestem	*Andropogon geraldii*	Grass	Moist/Tolerant	4-8'	4-5'
Tussock Sedge	*Carex stricta*	Grass	Moist/Tolerant	1-3'	3-5'
Switchgrass	*Panicum virgatum*	Grass	Moist/Tolerant	3-6'	2-3'
Swamp Milkweed	*Asclepias incarnata*	Herbaceous	Wet/Moist	4-6'	2'
Nodding Bur Marigold	*Bidens cernna*	Herbaceous	Wet/Moist	0.5-3'	1'
White Turtlehead	*Chelone glabra*	Herbaceous	Moist/Tolerant	1.5-6.5'	2'
Joe-Pye Weed	*Eutrochium purpureum*	Herbaceous	Moist/Tolerant	2-12'	5'
Rose Mallow	*Hibiscus moschueltos*	Herbaceous	Wet/Moist	3-6'	5'
Blue Flag	*Iris versicolor*	Herbaceous	Wet/Moist	3'	3-4'
Arrow Arum	*Peltandra virginiana*	Herbaceous	Wet/Moist	2'	2'
Blue False Indigo	*Baptisia australis*	Herbaceous	Moist/Well Drained	4'	4'
Obedient Plant	*Physotesia virginiana*	Herbaceous	Wet/Moist	3-6'	3-6'
Wild Ginger	*Asarum canadense*	Herbaceous	Wet/Moist	3-5''	spreads
Red Columbine	*Aquilegia canadensis*	Herbaceous	Wet/Moist	2'	2'
Blackeyed Susan	*Rudbekia hirta*	Herbaceous	Wet/Moist	1-5'	1-5'
Bee Balm	*Monarda spp.*	Herbaceous	Wet/Moist	2-4'	spreads
Rain Garden					
Red-osier Dogwood	*Cornus sericea*	Large Shrub	Moist/Tolerant	8-12'	6-9'
Red Maple	*Acer rubrum*	Large Tree	Moist/Tolerant	20'	39'
Sycamore	*Platanus occidentalis*	Large Tree	Moist/Tolerant	40-100'	40-70'
Common Ninebark	*Physocarpus opulifolius*	Medium Shrub	Moist/Tolerant	8'	8'
Swamp Azalea	*Rhododendron viscosum*	Medium Shrub	Moist/Tolerant	6-10'	6-10'
Arbor Vines					
Native Honeysuckle	*Lonicera sempervirens*	Woody Vine	Drought Tolerant	15-20'	1-3'
Trumpet Creeper	*Campsis radicans*	Woody Vine	Drought Tolerant	15-30'	1-3'
Virginia Creeper	*Pathenocissus quinquefolia*	Herbaceous Vine	Drought Tolerant	50'	1-3'
Low/No-Mow Grasses					
Hard Fescue	*Festuca brevipila*	Herbaceous	Drought Tolerant	30''	
Sheep Fescue	*Festuca ovina*	Herbaceous	Drought Tolerant	12''	
Chewings Fescue	*Festuca rubra subs. Fallax*	Grass	Drought Tolerant	18'	
Red Fescue	*Festuca rubra*	Grass	Drought Tolerant	24''	
Creeping Red Fescue	*Festuca rubra var. rubra*	Grass	Drought Tolerant	16'	
Dutch White Clover	*Trifolium repens*	Clover	Drought Tolerant	4''	
Native Meadow Mix	*variety spp.*	Grass	Drought Tolerant	Varied	

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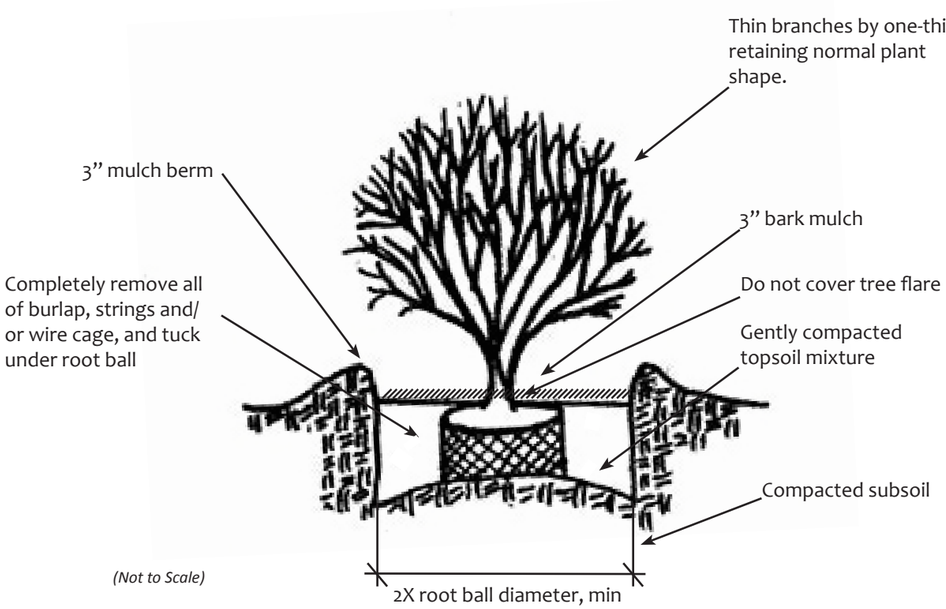
Tree and Shrub Planting Detail (Typical)



NOTE: This detail calls for tamping the subsoil to create a firm base upon which to place the shrub or tree root ball. The amended existing soil is backfilled carefully around the roots to support the plant and gently compacted to prevent air pockets from forming. A generous soaking after back filling is recommended to remove remaining air pockets around the roots. Prune back one-third of the foliage to stimulate root growth, taking care to retain shape. Do not use fertilizers. Water frequently for first season.

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Spring 2015

Cost Estimates & Phasing

PHASE I

	Unit	Path width(ft)	Quantity (Distance)	Unit Cost ($) Low	Unit Cost ($) High	Subtotal ($) Low	Subtotal ($) High
SOUTH PARCEL							
Boardwalk - wood	sq feet	5	1,880	35	55	329,000.00	517,000.00
Vegetation	sq ft		8,500	2	4	17,000.00	34,000.00
Crushed Stone Trail	sq feet	5	560	3	5	8,400.00	14,000.00
Signs	each		4	300	500	1,200.00	2,000.00
Benches	each		5	400	1,000	2,000.00	5,000.00
Sub Total						357,600.00	572,000.00
NORTH PARCEL							
Crushed Stone Riverwalk	sq. ft.	5	740	3	5	11,100.00	18,500.00
Overlook	sq. ft.		225	30	50	6,750.00	11,250.00
Vegetation Clearing (Thinning)	acre		0	4,000	6,000	1,200.00	1,800.00
Clearing/Grubbing around ex. Structures	acre		0	2,000	4,000	200.00	400.00
Benches	each		3	400	1,000	1,200.00	3,000.00
Signs	each		2	300	500	600.00	1,000.00
Sub Total						21,050.00	35,950.00

PHASE II

	Unit	Path width(ft)	Quantity (Distance)	Unit Cost ($) Low	Unit Cost ($) High	Subtotal ($) Low	Subtotal ($) High
SOUTH PARCEL							
Vegetation	sq ft		17,500	2	4	35,000.00	70,000.00
Observation Deck	sq ft		1,200	30	50	36,000.00	60,000.00
Wood Pedestrian Bridge	lump sum	6	80	20,000	25,000	20,000.00	25,000.00
Wetland Propagation Garden	lump sum		13125 cu. ft.	8,000	12,000	8,000.00	12,000.00
Resite/Expand Eco-Machine	sq ft		1,625	8,000	16,000	8,000.00	16,000.00
Wood Arbor/Trellis, 10' wide x 40' long	each		4	4,000	8,000	16,000.00	32,000.00
Benches	each		6	400	1,000	2,400.00	6,000.00
Boardwalk	sq ft	5	100	35	55	17,500.00	27,500.00
Sub Total						142,900.00	248,500.00
NORTH PARCEL							
Crushed Stone Trail	sq. ft.	5	3,300	3	5	49,500.00	82,500.00
Gravel Vehicle Access	sq. ft.	15	700	6	8	63,000.00	84,000.00
Gravel Parking	per space		18	2,500	3,000	45,000.00	54,000.00
Vegetation	sq ft		74,000	2	4	148,000.00	296,000.00
Benches	each		20	400	1,000	8,000.00	20,000.00
Picnic Tables	each		6	500	1,500	3,000.00	9,000.00
Meadow Enhancement	acre		3	4,000	6,000	13,200.00	19,800.00
Dry Wells	lump		1,800	6,500	10,000	6,500.00	10,000.00
Floating Dock	sq. ft.		1,200	30	50	36,000.00	60,000.00
Observation Deck	sq. ft.		850	30	50	25,500.00	42,500.00
Sub Total						397,700.00	677,800.00

PHASE III

	Unit	Path width(ft)	Quantity (Distance)	Unit Cost ($) Low	Unit Cost ($) High	Subtotal ($) Low	Subtotal ($) High
NORTH PARCEL							
Amphitheater (into slope)	lump sum		1,125	10,000	12,000	10,000.00	12,000.00
Ghost Granite Structures	lump sum		1	13,500	27,000	13,500.00	27,000.00
Vegetation	sq ft		10,890	2	4	21,780.00	43,560.00
Siting of Old Mill Equipment	each		8	3,000	5,000	24,000.00	40,000.00
Wood Pedestrian Bridge	sq. ft.	6	120	80	100	57,600.00	72,000.00
Wood Pedestrian Bridge	sq. ft.	6	150	80	100	72,000.00	90,000.00
Arbor	each		1	4,000	8,000	4,000.00	8,000.00
Canal Restructuring			35			-	-
South excavating	cu yd		1,500	20	25	30,000.00	37,500.00
Sub Total						232,880.00	330,060.00

Cumulative Sum Total	$ 1,152,130.00	$ 1,864,310.00
Mobilization (2%)	$ 23,042.60	$ 37,286.20
Construction and Surveying (2.5%)	$ 28,803.25	$ 46,607.75
Design and Administration (20%)	$ 230,426.00	$ 372,862.00
Pre tax amount	$ 1,434,401.85	$ 2,321,065.95
Taxes (6.25%)	$ 89,650.12	$ 145,066.62
Pre-contingency total	$ 1,241,780.12	$ 2,009,376.62
Contingency (12%)	$ 149,013.61	$ 241,125.19
Total + Contingency	$ 1,390,793.73	$ 2,250,501.82

Final costs to be determined after final construction documents are completed

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Phased Construction

For the purposes of implementation the masterplan is divided into smaller, more achievable projects. Each phase is particular to the northern or southern locations and are not required to happen concurrently. Easier steps come earlier in the sequences to help build momentum to complete the larger vision for both properties.

Phase I

Northern Parcel

- Strategically remove some vegetation around the dam in order to limit damage to the dams foundation.
- Construct a trail from the road to the dam along the river, benches, signs, and an observation deck near the dam.

Southern Parcel

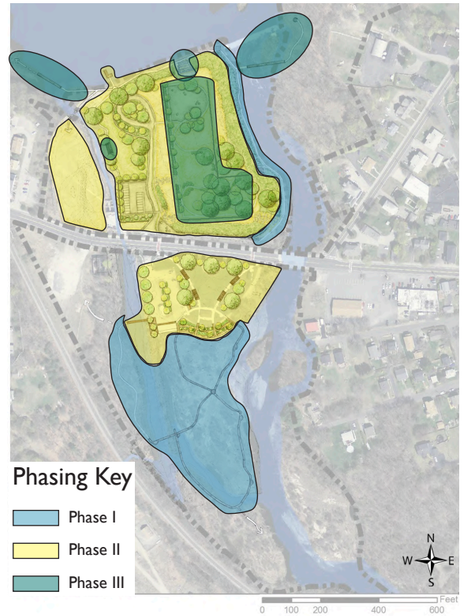
- Complete the boardwalk and canal-side trail, and add several interpretive panels.
- Add vegetation to the Mill Villages Park along with benches and interpretative panels.

Phase II

- Construct gravel trails, parking, driveway, drywell, and cul-de-sac.
- Add benches and vegetation around these elements.
- Stabilize all steep slopes with vegetation.
- Add a floating dock to the pond. Place an observation deck along the pond's edge.
- Move and expand the Living Systems Laboratory and add the observation deck.
- Connect the observation deck to the west side of the canal with a pedestrian bridge.
- Construct the wetland garden east of the Living Systems Laboratory.
- Add wood arbors above the Mill Village Park's sidewalks.
- Install benches for seating under arbors and along the river.

Phase III

- Complete major earthwork on eastern half of parcel to grade the site and make it universally accessible.
- Construct an amphitheater on the northern slope.
- Construct a bridge across the Blackstone River south of the dam to connect to the northeast parcel. Create a gathering space there.
- Add another bridge to connect the northern parcel to the northwest section of the towpath.
- Restructure the canal to increase the water level.
- Place mill equipment inside the ghost structure along with interpretive signs.
- Place benches throughout the property.



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